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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.

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Forthcoming Events.

DECEMBER 14.

Institute of Metals (Scottish Local Section):—Ordinary meeting. "New Alloys in the Brass Foundry," Paper by J. Arnott.

DECEMBER 15.

Sheffield Metallurgical Association:—Ordinary meeting. "The Past, Present and Future of Heat-Resisting Alloys," Paper by J. Ferdinand Kayser.

Institute of British Foundrymen.

DECEMBER 12.

Newcastle-upon-Tyne and District Branch:—Ordinary meeting. "Heat-Resisting Alloys," Paper by J. Ferdinand Kayser.

West Riding of Yorkshire Branch:—General discussion on Foundry Problems.

DECEMBER 17.

London Branch:—Joint meeting with the Institute of Metals. "Deoxidisers and Fluxes," Paper by G. L. Bailey.

DECEMBER 19.

Lancashire Branch (Junior Section):—Short Paper competition.

Developments in Cast Iron.

The number of Papers we have recently published, and appear likely to continue to publish, on special cast irons is a striking testimony to the remarkable advances now being made in this material. The lines of advance are several. The ordinary high-quality engineering cast iron of to-day has an all-pearlitic structure broken by comparatively small graphite flakes and small areas of phosphide eutectic and sulphide inclusions. Disregarding for the moment the various methods employed to achieve such a structure, several methods are employed for the purpose of improving it for various purposes. Thus an annealing treatment may be applied for the purpose of relieving casting stresses, but not for modifying the structure. A more drastic treatment of the same kind may be used for the purpose of softening for ensuring better machinability or as a preliminary to some form of tempering to secure physical properties not obtainable direct from the metal as cooled in the mould. In many such cases the metal is an alloy iron containing such useful elements as nickel and chromium, the use of which introduces another comparatively new technique into the foundry. The hardening process may be by air or by oil or by other means, and in this field the whole technique of hardening as developed in the steel industry is at our service, although it must be used with due discretion and guardedly. It can best be used to guide experimental work which should settle the details of routine processes.

We have also seen remarkable developments in the so-called austenitic cast irons, in which the structural condition which is usually only reached at high temperatures in the case of ordinary cast iron is actually caused to exist at ordinary air temperatures. At present this can only be done by the use of alloy additions, which depress the temperature at which the pearlite change occurs, until ultimately this is below air temperature. Doubtless cheaper means of ensuring the structure will be found, and this should be beneficial to the makers of the added elements as well as the industry, for the demand will rise as the cost falls.

All these developments point to the fact that cast iron is being used to-day not so much for its cheapness and convenience as for its intrinsic physical properties, and to improve these by the best composition and treatment is the real way of advance in the industry to higher prices, better status and freedom from the competition of the back-street manufacturer, who can cut in because he has little overhead and less knowledge.

More Custom of the Trade.

Founders should realise that, in asking us to state what we believe to be the custom of the trade, they are taking quite a serious step, for if our ruling remains unchallenged, by correspondence for example, it can be quoted fairly effectively in any legal action. It is therefore desirable not to get our ruling on cases which present any extraordinary features. We are not a lawyer, but we recognise that if legal action arises, the main duty of the judge is to interpret the law of contracts; he will try to ascertain what was in the minds of the parties at the time of making the contract, and he may or may not admit evidence as to what is the "custom of the trade" in such circumstances. The law of contracts is obviously the judge's main guidance.

Our latest query reads: "Can you please tell us whether there is any recognised practice in the industry with regard to the insurance against fire of customers' patterns? Does this responsibility rest with the foundry or should the owner arrange this?" In general terms, it is the duty of the foundry to cover by insurance the bare material cost of the patterns confided to its care, but this carries with it no consequential losses, such as penalties for late delivery, loss of profits and the like. Naturally, the cover extended by way of service by the founder is that which is accorded to him by his insurance company. For the small foundry owner, a limit of, say, £10 or £20 could be included in his tender-note conditions. By the way, co-operative insurance of patterns against fire risk could be an excellent service rendered by that nebulous national foundry owners' federation we are always advocating. We are aware that certain founders have covered themselves by insurance up to £40,000 for this risk of fire—and similar high figures are not unusual. If a customer attaches a value to his patterns not covered by the railway and transport companies' regulations, which are on fairly parallel lines with the indemnity accorded by the foundry owners, he should take out a special policy to cover himself, though normally the construction and retention of master-patterns is the safer and saner procedure.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Carbon Pick-Up in the Cupola.

To the Editor of The Foundry Trade Journal.

Sir,—I have read the letter from Mr. Dews in your issue dated November 26 with reference to the matter of carbon pick-up in the cupola. My disagreement with Mr. T. Goodwin, who stated that "carbon pick-up is unrelated to coke quality," is based entirely on experimental evidence. Like Mr. Dews, some years ago I made a point of collecting evidence on the behaviour of different brands of coke in relation to carbon pick-up, and with a series of six brands I was able to place these in order of merit. It may or may not be a coincidence, but the order of merit of these six brands of coke coincided with the order of "reactivity." Since this time I have confirmed the behaviour of these six different cokes on quite a number of separate occasions in separate foundries in various parts of the country.

So far as I know Mr. Dews is right in that there is no published investigation on the varying influences of British cokes on carbon pick-up. One reason for the absence of work of this kind is probably the extreme difficulty of obtaining conclusive results. This, however, does not make it any the less needful to attempt such investigations and I am in sympathy with Mr. Dews' desires on this matter.

There is ample evidence that there are other factors in the question of carbon pick-up in the cupola melting of irons. The condition of the air supply and the height of bed coke appear to be two factors of considerable importance. However, I am glad that Mr. Dews has drawn attention to this matter and I sincerely hope that some good result will accrue from it.—Yours, etc.

J. E. Hurst.

Sheepbridge Stokes Centrifugal Castings Company, Limited, Chesterfield.
December 2, 1931.

Book Review.

Faraday and his Metallurgical Researches, by Sir Robert A. Hadfield, Bt., F.R.S. Published by Chapman & Hall, Limited, 11, Henrietta Street, London, W.C.2. Price 21s. net.

The recent successful Faraday Centenary Congress held in London, at which honour was paid to the memory of the illustrious scientist by both British and foreign representatives of all branches of science and learning, coupled with the Faraday Exhibition at the Royal Albert Hall, South Kensington—an exhibition attended not only by the scientists and others drawn together by the Congress, but by large numbers of educationists, technical workers and hundreds of young people—served to bring to the notice of a larger public than ever heretofore the brilliant and scholarly efforts of one to whom must be ascribed discoveries of almost illimitable importance to mankind.

Sir Robert Hadfield, in the present handsome contribution to the existing publications covering the researches and discoveries of the great master, has, incidentally, crowned himself with honour; the present tribute being so thorough, so wholehearted, and so evidently the outcome of a labour of love on the part of Sir Robert.

The volume under review, the full title of which is "Faraday and his Metallurgical Researches, with Special Reference to their Bearing on the Development of Alloy Steels," will appeal to every metallurgist, and more particularly so to those whose interests are associated with the metallurgy of the alloy steels. Sir Robert, himself an ardent researcher and renowned discoverer in this particular field, is peculiarly fitted, both as a metallurgist and an author, to review and to present in the best form the work of the master; the result is a compilation of findings and happenings, theories and facts, experimental data and concise results, woven together in a masterly fashion and presented in a readable and fascinating volume containing numerous portraits, illustrations and photo-micrographs.

It will come, maybe, as a surprise to the majority of the younger readers of this work, to learn that the great Faraday—with whom they have hitherto associated researches and discoveries almost exclusively connected with electricity, magnetism and physics—devoted so much of his time and philosophical reasoning to the experimental study of the alloy steels: a branch of metallurgy which they doubtless regarded as being distinctly modern. Other names among earlier researchers might possibly recur to them, but it is opined that the much earlier work of Faraday in relation to alloy steels has in the past received but little attention from the younger generation of metallurgists. It is for this reason, if for none other, the reviewer is confident that in expressing his gratitude to Sir Robert for his generous tribute to the great master, he is voicing the wishes of a host of metallurgical researchers, many of whom, maybe, are happily retired, but who still retain a warm appreciation of the value of Faraday's pioneer research work. One is apt to overlook the almost insuperable difficulties attendant upon the pursuance of the specialised metallurgical work conducted in the great philosopher's laboratory. The preparation of even fairly pure metals in bulk was a somewhat laborious matter, and prices were almost prohibitive. It speaks well also of the then knowledge of refractories, without which such alloys as Faraday successfully attempted would have been impossible to produce in anything like sufficient weight for purposes of adequate research work.

Although Faraday's researches on steel and alloy steels, from a practical and commercial standpoint, were far in advance of the times, one must justly concede to him the premier place among the pioneers of the development of what is to-day a firmly established industry for the benefit of mankind. In the preface to his book, Sir Robert claims to have definitely established "that Faraday was the first to engage in systematic research covering the preparation of alloys of steel."

Sir Robert is in the envious position of having been permitted to examine the actual specimens, some 79 in all, preserved in "Faraday's Box" at the Royal Institution, where the master worked. The results of the examination and investigations connected with these specimens, although first published by Sir Robert in his Paper entitled "A Research on Faraday's 'Steel and Alloys,'"* are reproduced in the volume under review, together with like information respecting other specimens loaned to Sir Robert from the exhibits in the Science Museum at South Kensington.

The volume is comprised of a preface, ten chapters, two appendices, numerous plates, figures and tables, and is well indexed. Chapter I serves as an introduction both to the philosopher Faraday and to the famous "Faraday Box" and its contents; (II) describes the master's rise to fame; (III) entitled "The Stage and the Dramatis Personæ," gives biographical and other interesting notes of some score of savants, most of whom were Fellows of the Royal Society, including three former Presidents, all of whose portraits are reproduced; (IV) is descriptive of the "Early Workers in Metallurgy"; (V) "Sequence of Events"; (VI) deals with the birth and early

(*Concluded on page* 370.)

* A summary of the Paper appeared in The Foundry Trade Journal of Obtober 22, 1931.

Random Shots.

So the British Engineering Standards Association, to which the Institute of British Foundrymen has often lent valuable technical aid, is henceforth to be known as the British Standards Institution. I am sorry to hear it. But my sorrow wells, as it commonly does, from what is a quite negligible source. A matter, this time, of initials. Those of B.E.S.A. lend themselves admirably to that curt way we have with initials: of syncopising them in speech, whenever possible, to a dissyllabic "word." Thus the British Engineering Standards Association has long been spoken of as "Besa." An abbreviation which, despite the Association's change of name, is bound to persist for some time yet.

* * *

And the new initials, B.S.I., what of them? Pronounced individually they might, perhaps, be taken for a Cockney attempt at the famous "B.S.A."! But with a modicum of low cunning they can be resolved quite facilely into the exciting abbreviation of "Bessy." Mind you, I cannot think that the Institution itself would exactly welcome this tabloid title. And reference in discussions to "Bessy's" specifications and standards might, perhaps, strike members of learned societies as being deplorably flippant. Nevertheless, it would allow us to refer to the Institution in a term at once affectionate and commendably brief. So who's for "Bessy"?

* * *

American shopkeepers have not yet lost their sense of humour. One of them, while his store was undergoing repairs, hung out the notice: "No Business as Usual during Alterations."

* * *

What qualities, in what proportion, should the "perfect man" possess? American girl students are definite on the matter, as on any other. Their synthesis is given as personality 20 per cent., intelligence 20 per cent., cultural and social background 15 per cent., personal appearance 15 per cent., dancing ability 10 per cent., courtesy 10 per cent., physical fitness 5 per cent. and social poise 5 per cent. These figures are interesting. They rule out many of the types of male our fiction-writers vest with perfection. The "lounge lizard," the he-man, the E. M. Dell volcano cannot qualify for the pedestal. Nor can "Marksman" or even G. B. S.

* * *

Much more interesting, however, would be the recipe given by business men for the perfect business man. Now the perfect salesman, I imagine, would combine 45 per cent. intelligence with 45 per cent. personality, the remaining 10 per cent. being "charm"—an attribute the blend of many likeable traits. But as to the perfect foundryman I am puzzled. Having written down 90 per cent. intelligence, 30 per cent. personality, 25 per cent. physical fitness, 20 per cent. courtesy, social poise 15 per cent. and personal appearance 5 per cent., the conclusion I've arrived at is that something more than a mere perfect man—a superman, in fact—is needed for the perfect foundryman. And don't we know it!

Marksman.

Moulding a Blowing-Engine Piston in Loam.

By Hans Eckart.

(*Translated from "Die Giesserei."*)

In the following article an example of the moulding of a piston for a blowing engine in sand with sweeps is described.

Making the Sweep for the Mould.

Fig. 1 shows the section A and the plan view B of the piston. The upper surface contains six circular openings for the cleaning of the casting,

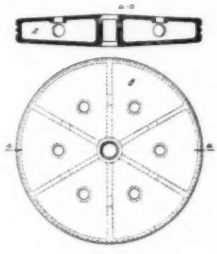


FIG. 1.

which are closed again later. Six ribs in the inside strengthen the casting. The first work for the patternmaker is the making of the two sweeps. Fig. 2 shows the sweeps for the upper and lower part. The piston has a diameter of 13 ft. 1½ in. and is swept up by using a spindle of 3 in. dia. The upper strickle is made separate from the lower. The lower strickle contains the complete section for the mould and the cores

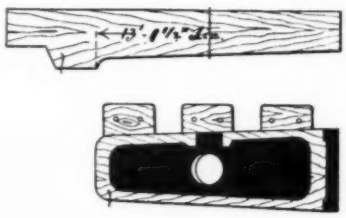


FIG. 2.

and is screwed on to the upper strickle by three lugs.

Making the Sweeps for the Core.

From an economical point of view and on account of the large dimensions, the core is made in a core box, built up of bricks. The required strickles are shown in Fig. 3; they are (*a*) the strickle for the upper part of the core and (*b*) the strickle for the brick core box, which for this purpose is screwed on the upper strickle (*a*). Six patterns for the ribs, Fig. 4, being

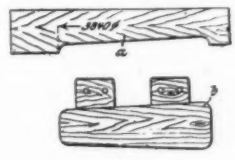


FIG. 3.

parted at (*a*), and six patterns for the reinforced openings, Fig. 5, are required. The latter are rammed into the surface of the core. For forming the boss a pattern, Fig. 6, has to be made with a hole of 3¼ in. Fig. 7 shows the spindle *b*, the bearing (*a*) and the collar (*c*), supporting the strickle arm, shown in Fig. 8.

Making the Mould in the Floor.

Primarily a pit is prepared in the foundry floor as shown in Fig. 9 at A. The coke bed, 1 and 2, is vented through four pipes, 3 and 4. A shows the complete lay-out for sweeping the lower part of the mould; at B are shown the gates or runners 5 and 6, rammed in by means of a strickle, being set at six or eight places equally distributed over the whole circumference. This has to be made with great care in order not to shift them from their original position.

FIG. 4. FIG. 5. FIG. 6.

The lower strickle is now taken off from the upper one and then the mould for the cope is swept, as illustrated in Fig. 10. The runners 1 and 2 are connected with each other by a ring, 3, for distributing the liquid metal over the whole mould. This being done, a circle is drawn with the strickle with a radius equal to the dis-

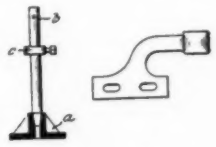


FIG. 7. FIG. 8.

tance of the openings from the centre and divided into six equal parts. At each of these six points, a gate is prepared in the cope as shown, at 10 to 12, in the plan view. Also in this figure it will be noted half of the cope is shown placed on top of the mould. At 15 and 16 the two feeding gates are shown. Before the

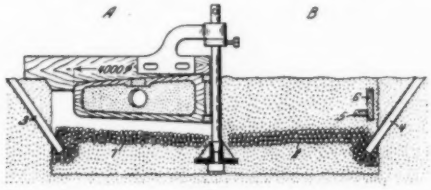


FIG. 9.

cope is put on, a 1½-in. layer of stiffish loam is put on the surface of the mould, then the latter is covered with wet paper, over which some sand is thrown.

This gives the advantage that the cope does not need to be turned over, since by this method no cavities result. After drying, the layer of

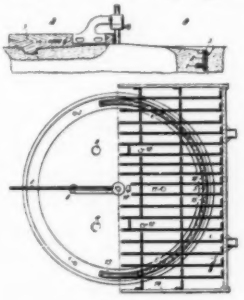


FIG. 10.

loam forms a good resistance against the pressure of the metal above the core supports. Fig. 11 shows the rammed cope 1 after being taken off, 2 is the circular gate, 3 and 4 the risers for venting the cores, 5 and 6 the two risers, 7 the vent for the core of the bolthole, and 8 one of the gates.

After the cope is removed, the distinctly perceptible centre lines on the surface are prolonged to the rim and there fixed by slit screws, whose slits are directed to the centre in order to locate the openings which have to fit exactly in position with the now finished gates. Now begins the forming of the lower part of the mould. The

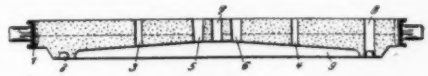


FIG. 11.

rammed sand is dug out sufficiently deep so that the lower strickle will form the underside of the mould. The mould being struck up, the rammed-in patterns for the runners are withdrawn, the mould finished, reinforced with nails, blackened and dried.

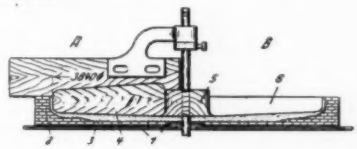


FIG. 12.

The Making of the Core.

As already mentioned, the core is made in a mould, built up of bricks; Fig. 12 is a section through it. The wall 2 rests on a plate. The finished brickwork is washed with a pulpy mass of sand and roughly swept. When dry, it is

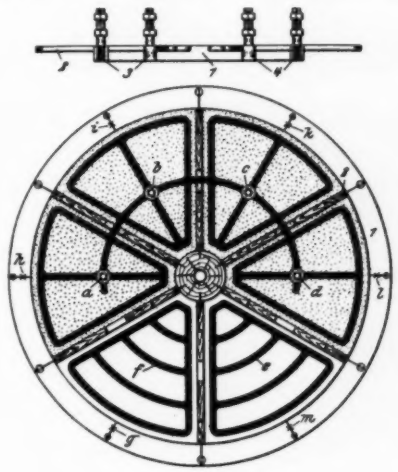


FIG. 13.

covered with a layer of plaster of paris and cleanly finished off with the core board. The core box is then divided into twelve equal parts, six centre lines are for the patterns of the ribs and six lines are the centre lines for the eyes (Fig. 5). The pattern for the boss is now

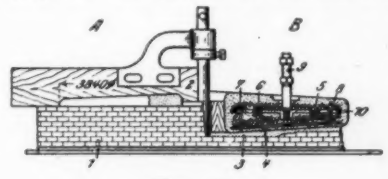


FIG. 14.

placed into the mould after the core board has been removed. The finished core box is shown at 6. Fig. 13 shows the required core irons. The supporting ring 1 connects the six single cores through the holes in the ribs and unites them to a whole structure. At 2 is to be seen the weaker upper core iron, forming with the ring 1 a single piece, at 3 and 4 the bolts with double nuts for handling the core after finishing. The plan view shows the core box from

above with the six ribs 2 and the twelve slit screws on the circumference. The pattern of the boss has also six centre lines, which correspond with the direction of the slits. The simple core grids *e* and *f* are first laid on a layer of sand and fastened to the main core grid by means of hooks and wire. Fig. 14 shows the rammed core at A with the upper core board. Before

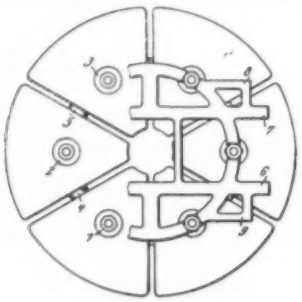


Fig. 15.

sweeping, the bolts are taken out and the holes filled with rags in order that no sand will drop in. The cores are now well vented, the reinforcing eyes put in, the surface well reinforced with nails, finished off and the upper parts of the rib patterns and the eye patterns are drawn out. Fig. 14 shows at 3 the swept layer of sand, 4 the first layer of core sand, 5 and 6 the connection of the upper with the lower bed of coke, at 7 and 8 the hooks, at 9 the reattached bolt, whilst 10 shows a part of the core free of the brick wall.

The finished core, seen from above, is shown in Fig. 15. The rammed eyes 1 to 3 and the

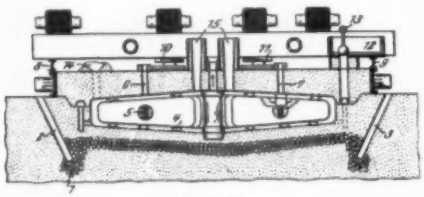


Fig. 16.

lower halves of the ribs are drawn; 4 and 5 are the connecting holes between the single cores. A special grid 8 and 9 with the extensions 6 and 7 is now put on the six screws, and serves for the handling of the core by the crane. The core is now brought into the drying stove and then put into the mould, the bolt holes being filled with small coke. After the core for the bore hole is put in place, the mould is closed as shown in Fig. 16. The cores are placed on strong chaplets 4. At 5 is to be seen the iron ring connecting the six cores with each other. The cope has to be well weighted in order to overcome the static pressure of the metal.

Aqueous Solutions for Quenching Steel.—A steel equivalent to or possibly better than the water- or oil-quenched and tempered steel would often be possible if quenching solutions were available possessing characteristic cooling rates between those of water and oil. In a recent investigation at the U.S. Bureau of Standards a study was made of aqueous solutions of ethylene, glycol, glycerine and sodium silicate to determine whether any of them offered promise as quenching media with characteristic cooling rates in this intermediate range. It was found that the solutions of glycol and of glycerine did not give results which were readily reproducible. Hence, such solutions did not appear promising for practical use. However, solutions of several concentrations of sodium silicate proved to have quenching rates in the desired intermediate range and to give very consistent results. Some of these sodium-silicate solutions must be treated with small additions of caustic soda in order to prevent changes in them when allowed to stand for several months. The effect of varying the concentration and the temperature of the sodium-silicate solution was studied.

1831—1931.

William the Fourth had just been crowned when Mr. Charles Walker started a little business in Rotherham to supply the local foundry industry with coal dust, graphite and other sundries. This enterprise is still flourishing, and has acquired a national reputation under the name of his two sons—Isaac and Israel Walker—at Effingham Mills, Car House, Rotherham, and is owned by Mr. Francis Everard Leyland Walker, the son of Mr. Isaac Walker. Mr. Walker, who has every cause to be proud of the centenary of the establishment of his firm, is one of the original members of the Institute of British Foundrymen, which was founded in 1906. He is very prominent in local affairs and is a member of the Council of the Rotherham Chamber of Commerce and a life governor of the hospital. Mr. Walker's works are situated just north of Rotherham and Masborough Station and cover about 12 acres. They have direct communication with the L.M.S. Railway and

Mr. F. E. L. Walker,

whose works this year celebrate the centenary of their establishment by his grandfather.

possess their own sidings. The works were remodelled in 1921, when the best available electrically-driven labour-saving machinery was installed. It is interesting to note that a 24-hours' service is in vogue at the works in order to ensure promptness of delivery in any emergency. Though this firm is of ripe old age, it is pleasing to note that there is no suspicion of senile decay setting in. In fact, their manufacturing methods are well abreast of modern requirements. For instance, all raw materials are tested in the laboratory as a matter of routine before acceptance. Processes are scientifically controlled from both chemical and physical aspects, whilst the final product is similarly tested to ensure it conforms to the high specification set by the firm before stocking or despatch. Thus, whilst the valuable experience which has been gained over such a long period of existence is utilised to the full, nothing is left to chance, and "rule of thumb" is rigorously excluded. Finally, we congratulate Mr. Walker and his firm on achieving its centenary of useful service to the foundry industry.

Death of Mr. Herbert Jewson.

We sincerely regret to announce the death of Mr. Herbert Jewson, who for 35 years directed the engineering activities of Messrs. Hobbies, Limited, of Dereham, Norfolk. We were little more than a student when we first met Mr. Jewson at one of the earlier annual conferences of the British Foundrymen's Association, held in Birmingham under the Presidency of Mr. F. J. Cook. As a young metallurgist, we were immediately impressed that the control of the foundry industry was a profession calling for the close collaboration of the engineer and metallurgist. He, more than any other individual, showed us very early in life how helpful these annual manifestations could be. By the irony of fate, some years later we occupied the chair of the Institute of British Foundrymen in his place, as an extended world-wide business trip, combined with failing health, precluded his passing from the Vice-Presidency to the normal fulfilment of the office of President. Mr. Jewson was something of an inventive genius, and anybody visiting the Dereham factory will find a number of machines which "Mr. Herbert" has created. Unlike most engineers of his day—Mr. Jewson was 68 years old—he took a serious interest in the foundry, especially the mechanical production of moulds. On the metallurgical side he was enthusiastic only in so far as it was capable of mathematical expression. There were sides of Mr. Jewson's business activities, however, which were unknown to his foundry friends; for instance, at one time he was in charge of a gunboat on the Nile under the command of Kitchener. Later he was in charge of heavy and important constructional work in Persia. During his long association with Hobbies, Limited, he made frequent visits to all parts of the world in their interests. Another activity of which his business friends were not generally cognisant was his interest in local affairs, and in 1922 he presided with great distinction over the District Council, whilst still maintaining the office of President of the Durham Branch of the Y.M.C.A. He was also a very prominent Freemason and held Provincial Honours. He held membership in several learned societies, but his especial interests were the Institute of Mechanical Engineers and the Institute of British Foundrymen. Mr. Jewson retired from active participation in the works about two years ago, when most of his activities were taken over by his nephew, Mr. Kenneth Jewson. As Mr. Kenneth is already so well known in engineering and foundry circles, it will be to him personally that most of us will express our condolences.

British Cast Iron Research Association.

The following firms have been elected to membership of the British Cast Iron Research Association. Their official representative is shown in brackets:—F. R. Cass, Bury (Mr. F. R. Cass); Higgs Motors, Birmingham (Mr. W. F. Higgs); High Speed Steel Alloys, Limited, Widnes (Mr. W. F. Rowden); Murex, Limited, Rainham (Mr. Henry A. Green); The Robert Mitchell Company, Limited, Montreal (Mr. A. M. Mitchell); S. Russell & Sons, Limited, Leicester (Mr. S. H. Russell); Allan Ure & Company, Limited, Glasgow (Mr. A. F. Ure); Worthington-Simpson, Limited, Newark, Notts (Mr. James T. Graham).

Trade Members.—Alldays & Onions, Limited, Birmingham (Mr. F. W. Berk); Pneulec, Limited, Smethwick (Mr. J. H. Parry), and Sternol, Limited, London (Mr. W. G. Smith or Mr. J. W. Fulwell).

An order worth more than £100,000 for cotton textile machinery, for use in India, has been secured by Messrs. Tweedales & Smalley, Limited, Manchester.

The Falkirk Foundry Industry.

The opening meeting of the Falkirk Section of the Scottish Branch of the Institute of British Foundrymen was held in the Welfare Hall of the Falkirk Iron Company, Limited, on November 14, when there was an exceptionally large attendance. Mr. Robert Ure, of Carron Company, retiring chairman of the section, presided.

The CHAIRMAN, after welcoming the members to the activities of a new session, said that the time had come for him to vacate the chair in favour of his successor, Mr. J. M. Primrose, of the Grangemouth Iron Company, Limited. He thanked them all for the support which they had given him during his term of office and appealed to them to continue that support to Mr. Primrose, who, he was confident, would lead the section to greater success and usefulness than it had already enjoyed. His tenure of the presidency had been one of much pleasure, and, he hoped, not unacceptable to the members of the section and the Scottish Branch. He now begged to introduce Mr. Primrose and ask him to take the chair and at the same time wish him as happy and interesting term of office as he had had.

MR. J. M. PRIMROSE, on taking the chair, said that he wished to thank them for having elected him to the chairmanship of the Falkirk section for the second time. He assured them that he would do everything he could to further the work of the section, the Branch and the Institute. He appealed to them all to do their little bit in helping on the work, not only for their own immediate good, but for the good of the whole British foundry industry.

Mr. Primrose then delivered his Presidential Address:—

Falkirk's Methods Reviewed.

Some years ago in a Presidential Address the speaker presented a short Paper on the history of the light-castings industry of Falkirk, and another year he compared local practice with that of America. The present attempt, which is in a way supplementary to those two Papers, is split up into two sections: (1) present practice and (2) future developments.

The first part is split up into four sections: (1) Rain-water and soil pipes; (2) connections; (3) gutters and connections; (4) stove-grate parts, combination grates and portable ranges.

Rain-Water and Soil Pipes.

The method still universal in Falkirk is the ordinary steel pattern, made one in a box, with a green-sand core, the core being made in a hinged cast-iron core box, the core bar consisting of a square wrought-iron bar varying in thickness from ½ in. to 1 in. In a few foundries attempts have been made at mass-production methods in a small way, the boxes either being rammed by hand on a stripping-plate machine, or rammed mechanically with sand slinger, and in one case a hydraulic squeeze machine is in operation, the cores in these cases being spun against a strickle, the core bar used consisting of a cast-iron tube or arbour. This arbour is about five-eighths the diameter of the pipe, yielding a small wall of sand. These mass-production methods of manufacture are confined mainly to 4-in. dia. pipes.

Connections.

Connections are mainly manufactured from shell patterns in two halves, the boxes being made by hand and the core being produced also by hand, using the pattern as a box. The core bar is made of cast iron cast in open sand the previous night, and broken when the casting is drawn from the mould. Certain suitable connections are made on a string, comprising two or four castings. These are mainly produced by hand, but in some cases jolt or squeeze machines are used for making the mould, but the cores in every case are still made by hand. In the case of string cores, these are made from specially-constructed core boxes in two halves and hinged on the side.

Gutters and Connections.

These do not, as yet, raise such an acute problem. They are mainly of British production and for the most part only used in our own country in cast iron. It would, however, pay for research, as by cheapening their manufacture a wider market might be found for their use. The competitive article in this case is galvanised sheet steel, which is durable enough in most countries owing to their climate, but it has no length of life in Britain. The double plate appears to offer the best line of attack in cheapening production along with a continuous cast, thereby reducing cost of boxes and minimising the area required for production.

Stove-Grate Parts.

Since the end of the war, methods of building construction have been entirely revolutionised, and foundries were too slow to recognise the changes that were taking place in their midst. The cost of registers and interiors did not keep pace with the requirements of the times, and the demand for the better article led to the introduction of the slabbed tile fireplace, which was a serious blow to the ironfounding trade. It is recognised, however, that this method has serious defects, and it is reasonably certain that with enterprise on behalf of the manufacturers, a great proportion of this trade could be recovered, and surely it is not outside foundry genius to produces something which, containing the artistic beauty of a tile fireplace, could also be produced at a price that would appeal. The lines suggested for attack are, first, to get the design or designs mutually agreed between architects, merchants, consumers and householders, and then thoroughly revolutionise pattern methods, shop practice, fitting and finishing. The grinding shop in the past has been the bottle neck, but other methods are already gradually overcoming this difficulty, and a continuous method of Berlin-black shop-practice would soon materially reduce costs in that direction. The difficulty in the past, and also at the present time, is the multiplicity of costly designs, costly patterns and costly plant, most of which are never use more than about 25 per cent. of the year. An examination of any foundry box yard would amply prove this statement.

Ranges.

When the old type range went out of fashion the living-room of the ordinary small house was made the cook shop by introducing the more ornamental type of cooking apparatus, and combining it with a living-room grate, and this has had large vogue during recent years. The gas-stove manufacturers have also made great progress, and personal opinion is that they are on surer lines, as it enables cooking to be done still in the back kitchen, which is, after all, the best place for it. The gas-stove trade, however, also has cheaper methods of production to face, and to keep and improve their trade they will require to go a step further, although at the present time it is the most efficient side of the light-castings trade in the country. In this trade plate patterns and standardised moulding boxes have reached their utmost limit of perfection, but a study of continuous methods of manufacture on the conveyor system would pay them, as the reduction in costs would be very considerable. It is common knowledge that 40 boxes can produce per day the output of 500 by present methods, and one pattern where 10 are at present required; one small cupola producing 4 to 6 tons per hr., working all day, doing the work of one large cupola, supplying the metal during a limited time per day.

From the coal-fire cooking point of view the small portable range seems to be coming back into its own. Manufacturers will require, however, to depart very considerably from the older designs, and a thorough examination of this type of range as produced on the Continent would be beneficial. Methods of manufacture, construction and finishing must be tackled wholeheartedly. In the meantime the trade is spread over too large an area. It is not possible for 20 foundries all working at a similar type to tackle the job economically. The moulding costs could be cut in half by more up-to-date methods, the fitting shop, grinding shop and finishing shop would also require to be tackled in an efficient way, and if this were done it is thought that a large part of the trade lost in this direction would be recaptured, and Britain could again profitably attack the export markets.

In an address to the Falkirk section in 1925, the speaker called the period then existing "The Plate Period," pointing out that although this method was pre-eminent locally, other countries were striving might and main to beat us, if not at our own game at least by other methods. It was also said, if a revolution in methods is to come, let it begin and be brought to success in our district, the cradle of the industry.

Have revolutionary methods since then been adopted locally? In some small directions changes have occurred since that address, but, generally, the district has little changed, while in the South of England and also on the Continent vast changes have and are occurring. These changes have not yet gone so far, however, that with great local tradition founders cannot follow and rapidly catch up.

Vote of Thanks.

MR. R. URE, in proposing a vote of thanks to the chairman for his address, said that Mr. Primrose had touched on many points of vital interest to the industry of their district and had shown the way in which many improvements might be effected in the running of the light-castings business, not only in Falkirk but in other districts. It was not usual to discuss Presidential Addresses, so he would content himself by asking them to accord to Mr. Primrose an expression of their appreciation of the very thoughtful and interesting address which he had given them.

MR. JAMES MILLER, immediate Past-President of the Scottish Branch, said that it was a great pleasure to be at a meeting of the Falkirk Section. He had to apologise for the absence of the President of the Scottish Branch, who had been called South on business and, therefore, was unable to be present as he intended, but he had asked that they accept his best wishes for a successful and interesting session. For his own part, he wished them a session full of interest and usefulness, and hoped that during its currency a great many more of those connected with the industry would become members of the I.B.F., and he appealed to them all to do their utmost to rope in new members. The Institute was an organisation of the greatest possible value to foundrymen. It provided an opportunity to learn of many phases of foundry work, and also for the discussion of their everyday problems and difficulties. It was often quite easy to find the solution to what appeared a difficult problem, when it was possible to discuss it with others and to get different points of view of the job. He once more wished the Section all success, and assured them that the Council of the Scottish Branch were watching their efforts and were willing and anxious to give them any necessary assistance.

TWO BLAST FURNACES at Gartsherrie, belonging to Messrs. William Baird & Company, Limited, were re-kindled recently after having been shut down for a considerable period. One furnace is on hematite and the other on foundry iron, and the total number of furnaces in blast in Scotland is now five.

D

Blast-Furnace Reactions.

Members of the West Yorkshire Branch of the Institute of British Foundrymen paid their first works visit of the session on November 14, when a party of about 50 gathered at the works of Dean, Smith & Grace, Limited, engineers and lathe makers, Worth Valley Works, Keighley. The visitors were welcomed by Mr. James Smith, director and son of Sir Harry Smith, governing director of the firm, and by Mr. Harry Smith, works manager. They were conducted over the works by their hosts and various members of the staff, and were shown the firm's foundry, where the Sandslinger was in operation, and the machine shops, where many machines had been kept coupled to electric motors so that the visitors could see them at work. At the conclusion of the works inspection the firm was accorded a hearty vote of thanks by Mr. A. S. Worcester (President of the Branch), supported by Mr. R. D. Welford (President-elect) and Mr. S. W. Wise (hon. secretary), to which Mr. James Smith responded.

The party adjourned to the Queen's Hotel for a light meal as guests of the new President (Mr. Worcester), to whom the thanks of the gathering were expressed by Mr. W. Parker (Past-President) and others.

Reactions in the Blast Furnace.

In the evening, Mr. Colin Duncombe Abell, analyst and chemical engineer, and late chief chemist to the Low Moor Iron Company, Limited, Bradford, gave an address—illustrated by many blackboard drawings and statistical tables—on "Reactions of the Blast Furnace."

In the course of developments of commercial processes in the iron and steel industry, said Mr. Abell, the application of scientific methods of control was tending to eliminate the semi-skilled operative, and to introduce the highly-trained expert who is capable of applying the results of research to industrial problems in such a way that better working efficiency was obtained, together with a great economy in labour and materials.

The address, although described as dealing with the reactions of the blast furnace, covered several aspects of the cold-blast-furnace process not usually dealt with in text-books. The matter put before the meeting arose as the result of research work undertaken by Mr. Abell during 1929-31. In dealing with the reactions between the materials in the different zones of the furnace shaft, the fact that the coke becomes impregnated and covered by a thin coating of reduced iron oxides was clearly brought out and substantiated by a series of interesting figures. The reduced iron oxides formed what the lecturer termed as "the iron residues," and the impregnated or solidified coke, he said, formed a support upon which these oxides and their related compounds traverse the whole depth of the furnace until the hearth zones are reached, where certain reactions take place which result in the desulphurisation of the iron in the iron residues, and the formation of small, but numerous, globules of molten iron which trickle down over the slowly-burning coke in front of the tuyeres and collect in the well of the furnace—the iron being tapped from the furnace at twice- or thrice-daily intervals, as the case may be.

In considering the equilibria in the furnace, said the speaker, one found that up to 900 deg. C. the initial reactions are chiefly confined to those of the dissociation of the carbonates in the iron ores, together with the partial reduction of the iron oxides to a mixture of ferrous and magnetic oxides, and a deposition of amorphous or granular graphite in the interstices of the material of the shaft due to the reaction between ferrous oxide, magnetic oxide and the carbon monoxide of the gas phase. These reactions result in the formation of the so-called iron sponge, a description which is rather a misnomer, since the reduced iron oxides, though containing metallic iron in a very fine state of division, do not contain sufficient to warrant using this term; in addition to which the term is at variance with the essential continuity of the process. The presence of this partially-reduced mixture of iron oxides is essential to the economy of the furnace, in that a deficiency of the oxides in the iron residues, when they reach the hearth zones, results in a great increase in the proportion of carbon monoxide in the zones immediately in front of the tuyeres, causing excessive decline in the temperature and producing an iron high in carbon, but low in silicon—*i.e.*, mottled—but seldom white iron, unless the coke charged was at the same time below the proper amount. The reverse conditions, it was pointed out, cause excessive oxidation of the iron, loss of iron as oxide in the slag, loss of manganese in the slag, excessive sulphur pick-up by the iron, loss of graphite from the molten iron required to make it grey, and an undue increase in the temperature, causing the production of white iron, the results being in every way comparable with excess of fuel and blast pressure—that is, with excessively heavy driving of the furnace.

The production of the impregnated coke in the shaft and upper bosh of the furnace is a result of the dissociation of the limestone to give free lime, which, at about 1,000 deg. C., combines with the silica of the gangue, ash of the coke, etc., and to some extent with alumina, the net result being the formation of a silicified coke of the composition almost of gehlenite, $2CaO.Al_2O_3.2SiO_2$. As the material approaches the hearth zones—as Mr. Abell described in illustration on the blackboard—a gradual change takes place, resulting in a mixture of gehlenite and its isotropic member, containing magnesia and known as åkermanite, $2CaO.MgO.2SiO_2$, such that it almost coincides with Vogt's isotropic mixture containing 55 per cent. of åkermanite, as follows:—(These analyses, said the lecturer, give the constitutional percentages of certain of the more important products found in the interior of the furnace, the calculations thereto, and further explanation of, are to be found in "The Industrial Chemist" for December, 1931.)

	CaO.	MgO.	Al_2O_3.	SiO_2.
Silicified fuel, shaft ..	52.00	—	7.10	40.90
,, ,, bosh ..	40.84	18.62	—	40.55
Amber slag, bosh ..	50.66	11.37	—	47.95
Deoxidation slag, hearth	33.00	—	18.75	54.25
White slag	50.10	—	10.87	39.03
Slag as run from furnace	51.96	—	7.16	40.88
Vogt's isotropic slag ..	37.74	8.08	—	40.44

The excess of one or other of the two compounds, gehlenite and åkermanite, and of sillimanite, $Al_2O_3.SiO_2$, in the different zones of the blast furnace determines the final constitution of the silicate residues of the slag and is a function of the rate of driving of the furnace, the temperatures at each level in the furnace, and the ratio between the amounts of alumina, lime, silica and magnesia, in the charges.

The occurrence of two zones in the hearth of the blast furnace was also demonstrated, the effect being due primarily to the proper proportion between the partially reduced iron oxides of the coke phase being maintained within certain limits not specified; these oxides oxidising the carbon of the coke immediately in front of the tuyeres forming a zone of comparatively high temperature, whilst in the central zones the normal combustion of the carbon takes place, resulting in the mixture, 2CO plus CO_2, being maintained under practically all conditions in the gas phase. The presence of water in the blast up to 0.50 lbs. per 1,000 cub. ft. is an advantage, since it catalyses the formation of the two oxides of carbon, the oxidation being otherwise such that a tendency develops for the carbon monoxide to be in excess. Actually, there is an excess of carbon monoxide, but it is immediately used up in reducing the impurities from the tuyere-metal mentioned in the following table:—

	Tuyere-metal.	Iron residues.	Iron as cast.
Si	0.58	7.42	0.77
S	0.090	0.180	0.052
P	Traces	0.250	0.340
Mn	Traces	0.510	0.520
T.C. ..	0.100	23.640	3.840
G.C. ..	0.000	?	3.210
C.C.	0.100	?	0.630
T.C. + Si ..	0.680	31.060	4.610
Fe	99.23	68.010	94.478

The high carbon of the iron residues is due, said the lecturer, in conclusion, to the deposited carbon of the shaft zones in the region 600-700 deg. C., where deposition takes place to the extent of about 20 to 35 per cent. of the material charged. The increase in volume is, of course, very great. Similarly, the silicon as shown is not all combined, but is present in such a finely divided form that it is as essential to the economy of this zone as the oxides from which it is set free. Mr. Abell stated that the results of his researches point to the fact that, in considering the equilibrium of the manganese and sulphur in the iron in the furnace and their effect on the graphite, that at temperatures above 1,480 to 1,500 deg. C. there is a complete change in the properties of the iron, and that in this respect cold-blast iron should not be superheated beyond this point if one wished to retain the original qualities of the iron.

A number of questions on points of detail were subsequently asked of Mr. Abell, who went into a good deal of detail in furnishing answers, in the course of which he raised some fresh points which were not discussed.

Vote of Thanks.

Mr. W. G. Thornton (Past-President), in moving a vote of thanks to the lecturer, said they had listened to a highly scientific address and one rather outside of their usual range of subjects. It was particularly difficult for any man to lecture on so scientific a matter and give it in a manner that non-scientific men could understand, but Mr. Abell, in the main, had managed to do that.

Mr. R. D. Welford, in seconding, remarked that the lecturer had not made reference to the weight of the heaviest thing that was put into a cold-blast furnace—the weight of air—which might be a matter of surprise to many when they heard it. Mr. Wise, supporting, said he believed they had all learned a good deal from the address, both in regard to blast-furnace practice and the effect of such reactions in the cupola.

Mr. Abell, replying, said the weight of air put into the furnace was practically equal to that of the materials put in. The heaviest of the materials was coke, of which about 90 to 100 tons would be put into a 70-ft. furnace.

Newfoundland and Crown Colonies and Protectorates.—Messrs. Erlangers, Limited (4, Moorgate, London, E.C.2), have now published Part V of the series of "The Manufacturing Industries of the British Empire Overseas." It deals with Newfoundland and Section I of the Crown Colonies and Protectorates, the latter including (1) the British West Indies, British Guiana, Bermuda and British Honduras, (2) Ceylon, (3) Malaya, (4) Hong Kong and the British Protectorates on the Island of Borneo. Like the four preceding parts of the series, it gives detailed information about area, population, industries, imports, exports and a great many other things. The published price is 2s. 6d., which considering the nine coloured diagrams, etc., must be considered extremely low.

Turbo-Alternators of 50,000 KW.

UNITS UNDER CONSTRUCTION AT C. A. PARSONS & COMPANY'S WORKS.

Messrs. C. A. Parsons & Company, Limited, at their Heaton Works, have under construction three 50,000-kw. turbo-alternators for the Dunston power station of the Newcastle Electric Supply Company, Limited. Our illustrations show one of these machines in course of construction. They are designed to operate with steam at a pressure of 600 lbs. per sq. in. and a total temperature of 800 deg. Fah., and are arranged for intermediate resuperheating up to the initial temperature of 800 deg. Fah. The units consist of two cylinder tandem turbines driving alternators at 1,500 r.p.m. Expansion takes place in the high-pressure turbine from the 600-lb. stop-valve pressure down to approximately 120 lbs. per sq. in., and at this pressure the steam is returned to the boilers for resuperheating and is then admitted to the low-pressure turbine, which is single-flow and which continues the expansion to the condenser vacuum of 29 in.

The turbines are of the pure reaction type, and the blading, which is stainless steel, is of the standard Parsons end-tightened type throughout the high-pressure turbine, and also for the high-temperature portion of the low-pressure turbine. The turbines are provided with a hand-operated stop valve and an independent automatic emergency valve. There are three governor valves housed in the steam chest, and each of these valves is connected to the corresponding turbine inlet by two flexible pipes. These three valves control the steam up to loads of 30,000, 40,000 and 50,000 kw. respectively. The most economical consumption is obtained at 40,000 kw., but a very flat consumption curve at lower loads is obtained by the provision of additional blading at the inlet end of the high-pressure turbine, the steam supply to which is controlled by the first valve. This blading enables the full heat drop available in the boiler steam to be utilised at a load of 30,000 kw., and it is by-passed when the load is 40,000 kw. Similarly, a further section of blading is by-passed for the maximum load of 50,000 kw.

The steam inlet to the low-pressure turbine is controlled by two valves housed in the steam chest, disposed on either side of the turbine and connected thereto by flexible pipes, as in the case of the high-pressure turbine. The provision of these valves is rendered necessary by the relatively large steam capacity of the reheaters and pipework. Two independent thrust blocks are provided in the high-pressure turbine, and the emergency governors are also duplicated. Feed heating by steam bled from the turbines is carried out in four stages. From the low-pressure stage heater the feed water goes to the feed pumps, thence to the intermediate pressure stage and then to the third stage, which utilises the evaporate from the evaporators. The steam for the evaporators themselves and for the final feed-heat stage is bled off at the exhaust of the high-pressure turbine before the steam passes to the reheater. The final feed temperature is 340 deg. Fah.

The alternators are designed to give a continuous output of 62,500 k.v.a., 13,500 volts at 1,500 r.p.m. The construction of the alternator is generally in accordance with the latest Parsons practice for large turbo-type alternators at this speed. The stator frame and the bedplate are of the built up, electrically-welded, construction, and present a very good appearance.

The stator conductors are insulated with the latest flexible insulation, which has been developed for high-voltage alternators. The conductors are of the laminated-cable type, and the individual strands are insulated with asbestos. The stator slots are formed so as to increase the slot leakage flux and thus the reactance of the alternator. The current on short-circuit due to a fault on the system is thereby limited, and the duty of the main switchgear is minimised.

The alternator stator coreplates are of a high-grade steel alloy, having low hysteresis and eddy-current losses; the coreplate segments, complete with slots, ventilation holes and key ways, are punched out in one operation so as to ensure the greatest accuracy in assembling. The alternator stator, which weighs 115 tons, will be shipped to the site completely wound.

(*Concluded on page* 368.)

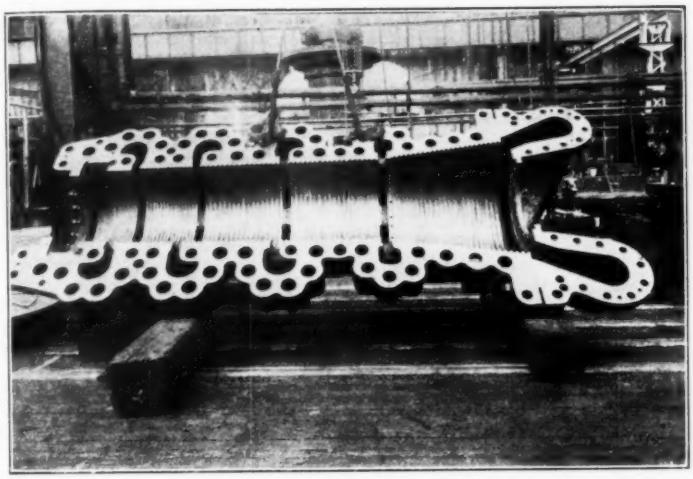


FIG. 1.—HIGH-PRESSURE CYLINDER COVER OF 50,000-KW. TURBO-ALTERNATOR.

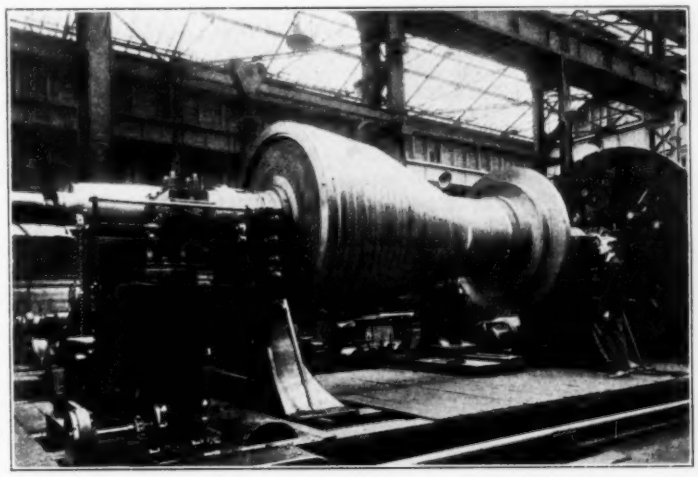


FIG. 2.—LOW-PRESSURE TURBINE ROTOR OF 50,000-KW. TURBO-ALTERNATOR.

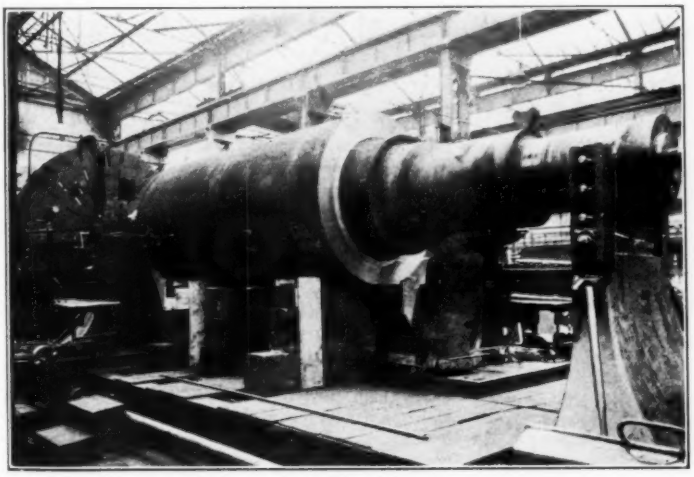


FIG. 3.—ROTOR SHAFT OF 50,000-KW. TURBO-ALTERNATOR.

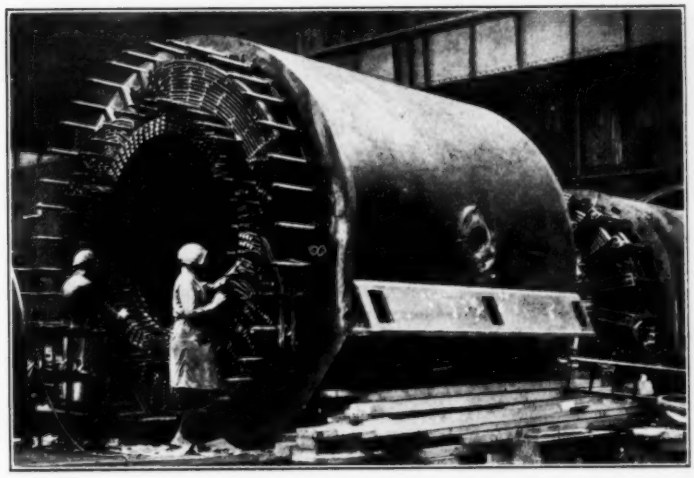


FIG. 4.—STATOR OF 50,000-KW. TURBO-ALTERNATOR.

Vanadium in Steel Castings.*

Carbon steel castings are widely employed in constructional work, but their application is still limited by their physical properties. When the stresses are light, low-carbon steel castings can be used to advantage. They are tough, reliable and economical. Additional strength obtainable by higher carbon contents and perhaps more drastic heat-treatment does not always effect the necessary improvement in yield point and the resistance to impact is often impaired. Consequently there is a demand for alloy steel castings into which may be introduced nickel, silicon, chromium, molybdenum, copper or vanadium, either alone, or in combination to comply with more stringent physical specifications.

Many combinations have been developed commercially, and each alloy metal imparts certain specific qualities to the alloy steel, and by suitable combinations of alloys almost any result can be obtained. It must be remembered, of course, that each product is a compromise and that one characteristic, as for instance, hardness, can be increased only at the expense of another, say, elongation. The designer must determine the minimum figure he needs for certain characteristics, and it rests with the steel maker to provide this with the least possible sacrifice of other properties. In the thickly-populated field of alloy-steel castings, vanadium steel castings have built up a well-deserved popularity over some twenty-five years, but it is doubtful whether their outstanding suitability for many purposes is fully realised.

Vanadium steel castings are specially notable for their high elastic properties, their resistance to wear, their long service when exposed to suddenly-applied loads and their ready response to simple heat-treatment. Castings containing vanadium are generally plain carbon-vanadium or chrome-vanadium steel.

A well-known and widely used carbon-vanadium steel containing C, 0.35; Si, 0.40; Mn, 0.90; and V, 0.18 per cent. conforms to the following specifications:—Yield point, 22.5 tons per sq. in.; tensile strength, 38 tons per sq. in.; elongation on 2 in., 22 per cent.; and reduction of area, 45 per cent.

By double normalising and tempering treatment of the castings, these figures can be slightly improved, the tests showing:—Yield point, 25 tons per sq. in.; tensile strength, 41 tons per sq. in.; elongation on 2 in., 25.0 per cent.; reduction of area, 47 per cent.; and Izod, 31 ft.-lbs.

This is a good illustration of the all-round improvement in physical properties imparted to an alloy steel by careful heat-treatment.

Nickel-Vanadium Steels.

The search for alloy steel of higher and higher mechanical properties has resulted in the evolution of products containing other alloy metals in addition to vanadium, which promise to be very useful for many purposes. Of these, the nickel-vanadium type is one which is firmly established commercially, after extended tests under service conditions. Two varieties of such steel contain respectively:—

Low C.—C, 0.22; Si, 0.35; Mn, 0.85; Ni, 1.50; and V, 0.10 per cent.

High C.—C, 0.28; Si, 0.35; Mn, 1.00; Ni, 1.50; and V, 0.10 per cent.

Their mechanical test values are as follow:—

Low C.—Yield point, 27.2 tons per sq. in.; tensile strength, 37.1 tons per sq. in.; elongation on 2 in., 29.0 per cent.; reduction of area, 59.1 per cent.; and Izod, 60.5 ft. lbs.

High C.—Yield point, 31 tons per sq. in.; tensile strength, 42 tons per sq. in.; elongation, 28 per cent.; reduction of area, 53.8 per cent.; and Izod, 47.8 ft.-lbs.

In these results the influence of the vanadium is fully illustrated by examination of test data of melts of the higher carbon grade, both with and without vanadium:—

Ni.—Yield point, 24 tons per sq. in.; tensile strength, 42 tons per sq. in.; elongation on 2 in., 27.0 per cent.; reduction of area, 56.6 per cent.; and Izod, 35.5 ft.-lbs.

Ni V.—Yield point, 31 tons per sq. in.; tensile strength, 41.5 tons per sq. in.; elongation on 2 in., 28.5 per cent.; reduction of area, 59.4 per cent.; and Izod, 74.3 ft.-lbs.

Nickel-vanadium steel castings are being used more and more in railway service, steelmaking plant and other industrial equipment, where resistance to wear and tear, resistance to shock and breakdown through vibration have to be guarded against. Their use, in fact, is extending constantly, and engineers would do well to bear in mind their excellent physical qualities when faced with problems involving these conditions.

Manganese-Vanadium Steels.

The manganese-vanadium type of steel casting also shows great promise. Pearlitic-manganese steel castings within the past few years have attained considerable industrial prominence, but their application is possible only within limits. Search for a substantial improvement in this class of steel has resulted in the commercial production of a manganese-vanadium cast steel of superior elastic and impact strength, and this already is attracting much attention. These properties in a steel of C, 0.35; Mn, 1.40; Si, 0.40; and V, 0.10 per cent. are shown in the following:—

Table I.

C.	Mn.	V.	Y.P. Tons per sq. in.	M.S. Tons per sq. in.	E. Per cent. on 2 in.	R.A. Per cent.	Izod. Ft.-lbs.
0.22	1.64	0.09	27.8	37.5	34.0	68.7	89.5
0.23	1.69	0.09	29.0	40.0	32.0	66.0	77.5
0.29	1.33	0.11	28.0	40.0	31.0	63.5	73.5
0.29	1.38	0.10	31.0	41.5	30.8	61.1	61.0

Table II.

Type.	Y.P. Tons per sq. in.	M.S. Tons per sq. in.	E. Per cent. on 2 in.	R.A. Per cent.	Izod. Ft.-lbs.
Ni Cr (*a*) ..	27.0	41	27.0	54.4	48.0
Ni Cr V (*b*)	31.0	42	28.5	55.8	71.3
Mn Mo (*c*) ..	31.0	51	21.0	41.6	18.8
Mn Mo V (*d*)	33.0	53	23.0	39.1	30.5

(*a*) C, 0.30; Mn, 0.60; Si, 0.40; Ni, 1.30; and Cr, 0.50 per cent.

(*b*) Same, with V, 0.10 per cent.

(*c*) C, 0.35; Mn, 1.50; Si, 0.40; and Mo, 0.15 per cent.

(*d*) Same, with V, 0.10 per cent.

Experimental.—Yield point, 35.0 tons per sq. in.; tensile strength, 46.0 tons per sq. in.; elongation on 2 in., 27.0 per cent.; reduction of area, 54.7 per cent.; and Izod, 49.0 ft.-lbs.

Commercial.—Yield point, 31.0 tons per sq. in.; tensile strength, 45.2 tons per sq. in.; elongation on 2 in., 25.0 per cent.; reduction of area, 51.9 per cent.; and Izod, 43.0 ft.-lbs.

Again the influence of vanadium is apparent by comparing experimental melts of similar composition, one with, and one without, vanadium:—

Mn.—Yield point, 26 tons per sq. in.; tensile strength, 45.0 tons per sq. in.; elongation on 2 in., 27.5 per cent.; reduction of area, 58.8 per cent.; and Izod, 25.8 ft.-lbs.

Mn V.—Yield point, 33 tons per sq. in.; tensile strength, 44.0 tons per sq. in.; elongation on 2 in., 30.5 per cent.; reduction of area, 61.8 per cent.; and Izod, 57.5 ft.-lbs.

Microphotographs of samples of this type of steel show very clearly the improved granular structure. The remarkable increase in yield point, accompanied by a more than two-fold increase in impact value, merits the careful consideration of engineers and designers faced with problems in the construction and maintenance of cast parts subjected to severe shock loads.

Manganese-vanadium steels of lower carbon content display similar advantageous mechanical properties, as may be seen from Table I.

Chrome-Vanadium Steels.

Plain chromium steel is likewise greatly improved by the addition of vanadium, as is evident from the following data, comparing steel C, 0.30; Mn, 0.80; Si, 0.40; and Cr, 1.00 per cent. with a similar one to which V, 0.10 per cent. has been added.

Cr.—Yield point, 26.5 tons per sq. in.; tensile strength, 42 tons per sq. in.; elongation on 2 in., 27.5 per cent.; reduction of area, 54.7 per cent.; and Izod, 38.3 ft.-lbs.

Cr V.—Yield point, 28.0 tons per sq. in.; tensile strength, 42.0 tons per sq. in.; elongation on 2 in., 27.5 per cent.; reduction of area, 57.1 per cent.; and Izod, 59.3 ft.-lbs.

The influence of vanadium is not confined to simple alloy steel containing only one other alloy metal. By its addition the more complex steels also are very materially benefited in respect to elastic properties and resistance to suddenly applied stresses; this improvement is adequately illustrated by tests of nickel-chromium and manganese-molybdenum steel castings with and without vanadium (see Table II).

The last group of tests discloses another important feature of cast steels containing vanadium. Without its addition, alloy steels, the composition or heat-treatment, or both, of which are adjusted to produce high hardness and tensile strength, show a rapid decrease in impact value, which very often is not tested or recorded.

Engineers have often overlooked the importance of the impact strength of cast steels even when applied to types of service where high impact value affords a great measure of insurance against failure. The combination of high yield point, high tensile strength and proportionately high impact resistance of the harder complex vanadium cast steels, are effectively portrayed in Table III.

All of the steels described in this brief article have been tested after a double normalising treatment, either with or without a subsequent tempering. In castings whose form will permit, more drastic heat-treatment, *i.e.*, liquid quenching followed by tempering, may be applied to produce still greater improvement in stress-sustaining capacity; here also the numerous benefits of a small vanadium addition will be apparent, not only in the test results, but also in many characteristics which greatly concern foundrymen.

Little mention has been made herein of constructional cast steel of higher vanadium content.

Table III.

Type.	C.	Mn.	Si.	Mo.	Cr.	Cu.	V.	Y.P. Tons per sq. in.	M.S. Tons per sq. in.	E. Per cent. on 2 in.	R.A. Per cent.	Izod. Ft.-lbs.
Mn Cr V ..	0.44	1.48	0.47	—	0.61	—	0.10	33	53.5	25.0	56.2	34.5
Mn Cu V ..	0.43	1.48	0.44	—	—	0.80	0.10	38	54.0	22.0	46.3	44.5
Mn Mo V (I)	0.45	1.53	0.48	0.16	—	—	0.10	37.5	57.0	20.5	35.0	30.3
Mn Mo V (II)	0.36	1.17	0.48	0.33	—	—	0.10	41.0	60.0	12.0	25.4	25.5

(*Concluded on page* 368.)

* From information supplied by High-Speed Steel Alloys, Limited, of Widnes.

Alloy Cast Irons.

By Gerald S. Bell, B.A. (Oxon.)

(*Continued from page* 354.)

Resistance to Wear.

This quality is, of course, largely related to the questions of structure and grain size. For some considerable time now nickel and nickel-chromium cast irons have been used in the automobile industry for making cylinder blocks, etc., and there have been many claims that considerably increased resistance to wear has been obtained. More recently, the use of these irons has been applied to locomotive cylinders, with, it is said, satisfactory results. Personal experience has been principally in the manufacture of liners for Diesel engines, and so far as

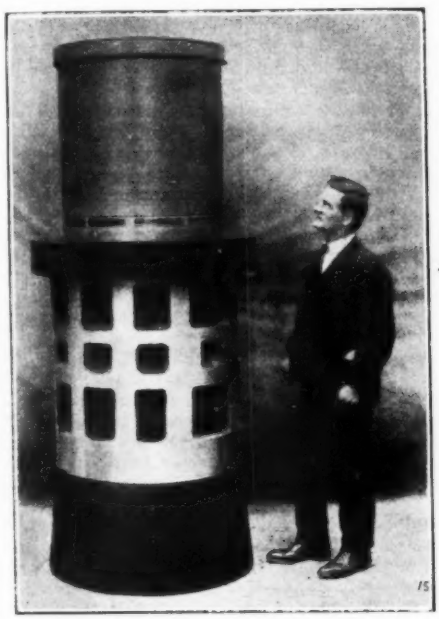


FIG. 1.—NICKEL CAST-IRON LINER, SULZER TYPE, MADE BY ROBEY & COMPANY, LIMITED.

wear is concerned on the 4-cycle horizontal Diesel engine and the 2-cycle vertical Diesel engine, it has proved entirely satisfactory. The application of pearlitic nickel cast iron to the manufacture of liners for big marine Diesel engines was therefore indicated. There is no other type of engine (particularly the 2-cycle type) in which the liners are subjected to such intense wearing conditions. Every marine Diesel engineer encountered considers the liner problem first and foremost from the point of view of wear resistance. In a certain very well-known type of 2-cycle marine Diesel engine, the average wear on the cylinders is 1/1,000 in. for every 1,000 miles that the boat travels. It will be appreciated that it is a very expensive business to renew the liners in these big engines, and therefore that any material showing increased wear-resistance will be very welcome. There are many factors which affect the question of wearing quality in marine Diesel cylinder liners, such as resistance to growth, uniformity of texture throughout the bore, closeness of grain, lubrication and so on. Personal experience has not yet been able to prove in practice that nickel cast iron resists growth any better than an ordinary refined cylinder iron, but it is known that it is no worse in this respect. On the other hand, the nickel iron does definitely give greater uniformity of texture throughout the liner bore, for reasons already indicated. This leaves the two remaining chief factors, viz., grain closeness and efficiency of lubrication. That the two are related to each other cannot be denied, but there is a distinct difference of opinion when it comes to the question of *how* they are related.

It must be remembered that the surface of the bore of a liner made in pearlitic nickel cast iron is much closer than it is in refined cylinder iron. One can only describe the ground finish of a nickel-iron liner bore as being mirror-like in appearance. There are two schools of thought. One of these states categorically that the closer the texture of the metal the greater will be the resistance to wear. The other school considers that a certain degree of openness in the metal definitely assists lubrication, mainly through the existence of minute pockets or cavities, which serve to retain the oil.

The author's firm has many nickel liners in Diesel engines in boats at sea which are being tried out, and on which reports will be submitted in due course. The first of these reports was recently received, and is, to say the least of it, distinctly encouraging. It applies to a liner of the Sulzer type (Fig. 1), which is for a two-cycle engine in which wearing conditions are severe. A boat was equipped with a five-cylinder Diesel engine, which was fitted with four liners of ordinary refined cylinder iron and one liner of pearlitic-nickel cast iron. The boat then proceeded to do a trip of some 16,000 miles, the engine was dismantled and the liners checked up. The wear on the nickel liner was found to be 30 per cent. less than the average wear on the remaining four liners of refined cylinder iron. This result is still more promising in view of the fact that the measurements were taken of "first wear," which is always the most intense. The boat is now on another long trip, and it is hoped that when further measurements are taken the nickel liner will show up equally as well in comparison, if not still better.

Corrosion and Erosion.

Consideration of wear perhaps leads one to the resistance which the material shows to the effects of corrosion and erosion. The author has carried out several experiments under working conditions, but has not found as yet that pearlitic nickel cast iron is any more resistant to corrosion than ordinary iron. Theoretically, this is not what one would expect from the homogeneity of the material, but, practically, no measurable difference has been found.

On the other hand, there have been instances when the material has shown good resistance to erosive action. One of these is in fuel-valve spindles for big Diesel engines. These used to be made in case-hardened steel, and considerable trouble was experienced with the erosive effect of the fuel oil. Pearlitic-nickel cast iron has solved the problem.

High Strength.

Provided that all normal precautions are taken in the preparation of the basis mixture, and in the alloying of the nickel, a tensile strength of 18 to 22 tons per sq. in. can regularly be obtained. This is on a test-bar 1.25 in. in diameter, cast separately and machined down to 0.798-in. diameter B.E.S.A. test-piece. As regards transverse tests, this almost without exception exceeds 4,000 lbs. ultimate stress on a 2-in. by 1-in. bar broken as cast on 36-in. centres. Thus it is not difficult to obtain consistently high strength in the material itself. In addition, it should be remembered that the strength of the material in each section of any particular casting is also raised on account of the even distribution of grain closeness.

With any alloy cast iron, one is a long way off the point when any appreciable replacement of materials such as malleable iron and cast steel can be effected. There are, and there will be to an increasing extent, odd instances of where this is done.

There seems to be little doubt that, as far as high strength is concerned, the main advantage in these alloy irons is that they can replace ordinary cast iron with a corresponding reduction in the scantlings, and the weight of the castings. There are, of course, innumerable instances of where reduction in weight is a distinct advantage, as for instance the drums of electric winders and electric haulage gears. There are cases, where, by increasing the scantlings slightly, pearlitic nickel cast iron has successfully replaced cast steel. In other cases, it has been able to replace ordinary cast iron and to reduce the scantlings, the advantage of which will be readily appreciated. Once again, however, one has always got to bear in mind the fundamental question of cost of material.

Chromium Additions.

Small percentages of chromium (added to the basic mixture in the form of ferro-chrome) have a marked effect in increasing the hardness of the iron, and its tendency to chill. Nickel has

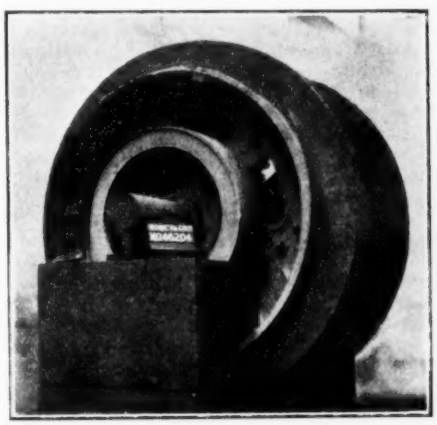


FIG. 2.—NICKEL CAST-IRON WINDING DRUM, FOR A SOUTH AFRICAN GOLD MINE, MADE BY ROBEY & COMPANY, LIMITED.

the opposite effect to this, though to a lesser degree. It has been found that, when the two elements are added to the mixture together in certain proportions, a counterbalancing effect is produced, which is beneficial in the following way:—The iron in the thicker and heavier sections of the casting is made still closer in structure than it is with the nickel addition only, but at the same time there are no increased chilling effects in the thin sections of the casting.

The ratio of chromium to nickel which is added has to be carefully regulated to suit the class of casting which is to be poured, and due allowance has to be made in the silicon content of the basis mixture to which the two elements are added. Generally speaking, however, the compensating effects of chromium addition can be gained if this is made in the ratio of one part of chromium to three parts of nickel.

The pearlitic structure of the combined carbon in nickel iron is made somewhat finer by chromium addition, but no figures or experiences are personally available tending to show that the wearing qualities or the strength of the material are appreciably increased. It should be noted that, when chromium is added to grey cast iron, an oxidation loss of between 10 and 15 per cent. should be allowed for. It is best to calculate on a basis of 15 per cent. loss.

(*Concluded on page* 368.)

A Note upon the National Position of Metallurgical Knowledge and Efficiency in Ordinary Ironfoundries.*

By Horace J. Young.

Introductory.

A time when the ironfounding industry suffers from dire depression is seasonable for each individual, possessing knowledge and experience of some particular part of the trade, to point out where savings can be made without degrading either quality or quantity of output.

Upon the above thought this Paper is presented by the author who for twenty or more years was an official in large marine engineering works and dealt with, among other things, the many scientific matters arising out of the production and use of castings for reciprocating, turbine and internal-combustion engines. Of all the manufactures for which he was responsible he liked cast iron the best and yet does. The unravelling of the intricate problems connected with turbine work, cylinder liners and piston rings for superheated steam and then marine Diesels—all these are remembered with pleasure, and the ways and means whereby success was attained are invaluable weapons with which to combat new difficulties.

Inlaid with these practical memories are others connected with the rearing and running of the important Institute under whose auspices this Paper was read. The old days were those of the amateur. Foundrymen, moulders, metallurgists, professors, everyone having energy combined with an intimate knowledge or experience of some other thing, gave of his best and for love only to the science of the industry, the running of the Institute and to those committees directly or indirectly associated with iron castings. The Transactions of this Institute during those years contain a record of knowledge which is put into new bottles or wrapped up in huge and gaudy parcels and thereby bettered not at all. To what degree this industry has been undermined by the recent universal worship of extravagance upon almost unproductive work or futile circumlocution is a point yet to be faced. The question: "What has the foundry trade got in return for so much expenditure?" will need to be answered by those who not only have at heart the national—as distinct from the particular or the personal—welfare but also possess the training and experience necessary to qualify them to act as accredited accountants in the drawing up of the balance sheet. Without doubt these matters are of major importance.

Meanwhile, it is in deference to the request of several old friends that the author attempts here to present in plain language his ideas as to how simple economies are possible in many foundries, together with some summary of modern foundry metallurgy. This Paper limits itself to the experience of its author. Working from London as a centre, he has charge of foundries some as far away as Scotland, and so he is able to present a fairly wide view. Obviously, also, his very livelihood depends upon his successfully putting his preachings into practice—in other words, he has to do the job. In this connection, it is interesting to note that in six years of independent working he has met two foundries only which did not benefit from the introduction of metallurgy, those being cases which, in the light of his present knowledge, he could recognise and avoid.

The Ordinary Foundry.

Few foundries possess employers or employees who can read—far less digest—the mass of metallurgical literature nowadays provided for them, and which, we are told, brings to them valuable commercial benefit. The author has visited foundry after foundry to find that—apart from the mechanised side—there is not one iota of difference between their methods to-day and those before the war. How should there be? Can a foundry intelligently and advantageously apply metallurgical knowledge, which it takes a lifetime to assimilate, unless it employs a metallurgist? Even so the calibre of that employee's work will be precisely in accordance with his market value, and how many foundries can afford to pay for sound training and long experience? The result is that the ordinary foundry lives upon its old knowledge plus the advertisements in technical magazines. Moreover, young and inexperienced metallurgists are in the same boat, and it is a common experience, when visiting a foundry where a small laboratory functions, to discover that they are using raw materials of an expensive nature or purchased a long way off and carrying heavy freight charges. In other words, the science is there but lacks direction, experience and courage, and, under such conditions, is starved as a commercial asset and becomes a little circumlocution department of no account.

The ordinary foundry usually has a good foreman. The cupola has a fan or blower giving a volume of air which nobody there knows or is much the better off if he finds out. The irons are purchased either by a commercial department or the works manager, or, in wiser places, by instructions from the foreman. These irons when delivered are mixed according to the judgment of the foreman or according to mixtures established when the irons were different from what they are to-day or will be to-morrow. In any case, unless they are certain expensive irons, no two consignments are often alike, hence no two results of thus mixing them are alike. These are facts which existed before the war and no less exist to-day. Examining many average foundries, one can say unhesitatingly that they prove our foundrymen to be second to none and our understanding and use of applied science to be hardly advanced from 25 years ago.

Cost of Metallurgical Control.

The answer to this grave position is that every foundry or group of foundries can gain the advantages and economies of scientific control only by employing experienced science. Its employment need be such a small expense that it is within the reach of all. At one time the cost would have been in the neighbourhood of a thousand a year including wages, chemicals and upkeep; to-day, as the result of organisation and experience, a mere fraction of that amount would cover the total cost. Moreover, two or more small foundries in any one district by combining may reduce the cost to each to a negligible sum.

Economies and Advantages of Metallurgical Control.

These are better illustrated by an exact example. An English foundry turned out weekly some fifty tons of engine castings. It made splendid castings, and, apparently, little improvement was possible. But it was using irons from a far source, also Scotch irons, also refined irons. Incidentally, its best internal-combustion-engine iron gave about 15 tons tensile, and like all their other cast irons was seldom twice alike. Metallurgical control wiped out *all* expensive irons. It standardised five definite qualities of cast irons so that each quality never varied in its composition, its foundry behaviour, its machining properties and its service results. It raised the strength of the best cast iron to between 18.5 and 21 tons tensile. The saving per annum on cost of raw materials was some ten or more times that of the cost of the metallurgical control. Additional advantages were tremendous. Irons were produced which the moulders, the draftsman, the machine shops and the users could calculate and depend upon. Each cast iron was a known unit, which could be improved or altered according to experience of its service results. Year after year there were no variations, and always the raw material was purchased in the cheapest markets.

Standardisation Essential.

Non-ferrous alloys have been developed by standardisation. Muntz metal, for instance, is 60:40 brass, made from the same type of mixture and to a standard composition with very small tolerances. From that old alloy have evolved complex propeller and other brasses, some with enormous strengths, yet throughout has run standardisation of type of mixture and standardisation of composition. The same applies to the gun-metals, the red metals, the light alloys. The same applies also to the steels. Yet, in cast iron the vital advantages to be gained by standardisation have been blurred by the propaganda not of foundrymen but of certain of those who live on foundrymen. The result is an annual waste of hundreds of thousands of pounds upon raw materials, and that by an industry literally gasping for financial breath. If anybody attempted to tell, he was a single crystal set among many loud speakers.

Any Quality of Iron from any Pig-Irons.

During the war the author had charge of and responsibility for the production of hundreds of Admiralty castings of the most important and difficult description. One particular lot was forty sets of castings so tricky that another and important foundry had always, before the war, to make two in order to make one good one. Another batch was internal-combustion engine castings of the highest order. The author began his internal-combustion work by purchasing air-furnace-refined pig-iron regardless of cost. He found that he could never obtain it twice alike, and that the makers could not deliver it true to their own specifications or to anybody else's. The records of this are in black and white for those who choose to examine. As time went on the author was compelled to drop air-furnace and—*mirabile dictu*—found he could do without it. Later he could not obtain any iron save miscellaneous lots of what, previously, would have been called bastard irons. Still more wonderful to relate, he found that it was possible to use anything. Indeed, the analyses of the pig-irons used by him in those days are little less than staggering. But they made no difference under scientific control. The forty sets of castings previously referred to were cast and machined without a failure, their production being spread over many months and involving many different kinds of pig-irons. The Diesel work, the superheated steam cylinder-liner work, the turbine work, all went on, and the tests were obtained together with good castings and good service results.

During that period a foundry in China having an important Government contract could get no pig-iron which it could use. The author was employed to go to Whitehall and crave for iron. Finally, all he could get were some lots of pig-iron such as no self-respecting foundry would look at. He analysed them before they left this country, made up mixtures which were sent out to China, and the castings were made successfully and without trouble of any kind. These records also are intact and may be seen.

Nothing but the Truth about Pig-Iron Wanted.

One arrives, therefore, to the proved and established fact that one can make any class of

* A Paper read before the East Midlands Section of the Institute of British Foundrymen at Leicester, Mr. T. Spiers presiding.

cast iron from a selection of *any* English or Scottish pig-irons. The author does it daily and has done it for six years in foundries all over the country. It is his long-standing opinion that nothing will do more good to purveyors of genuine pig-iron or more harm to nostrum-mongers than the bringing home of these truths to foundry owners. Good blast-furnace pig-irons and refined pig-irons are wanted by everyone, but the inflated prices asked and false claims for pseudo-irons, cupola fluxes, and so on, are things which can be abolished to the benefit of everyone interested in the ironfounding business. Some pig-iron firms publish accurate analyses of their irons—accurate as regards even total carbon—and show microphotographs of the heart of the actual pigs. Such procedure on the part of all genuine concerns would put to a speedy end the flummery which has degraded the trade and made its pamphlets and its claims of no reliable account to any save the ignorant. Good pig-iron no more needs making mis-statements about than does any other genuine material.

Little Metallurgical Progress in Ten Years.

Before the Institute of Marine Engineers at the Shipping, Engineering and Machinery Exhibition at Olympia as far back as 1923, the author showed that he was making cylinder liners of 3½ tons weight and 2½ in. thickness. He gave the following figures on seven test-bars cut out of the "casting head" and seven cut out of the bottom of the casting. The average tensile in the "head" was 16.69 tons and the average transverse 3,479 lbs. (on Admiralty inch-square bar); at the bottom the average was 18.38 tons tensile and 3,669 lbs. transverse. To-day but few foundries attain these figures from ordinary test-bars, far less from *bars cut out of actual castings*. Dozens of such liners were supplied for superheated steam engines and for internal-combustion engines. They gave records of service which have not been surpassed. The same "type" of iron was made for piston rings, and there, again, was success obtained. Very complicated Diesel heads and covers were made, and there is no record of any one having cracked in service. It would appear, therefore, that during the past ten years foundries have progressed but little and at terrific cost.

Expensive Raw Materials Usually Unnecessary.

It is possible, using a selection of any English or Scotch pig-irons, to produce from a cupola that quality or those qualities of cast iron which can be produced from that cupola using any *other* pig-irons. The statement is equally accurate as applied to all types of furnaces. Therefore, there is no reason to spend money upon high-priced raw materials, unless it be proved that by so doing we make something which cannot be made without those materials.

It is not uncommon to find foundries paying high prices for low-silicon low-carbon irons containing less than 0.05 per cent. of sulphur. They melt these irons in a cupola, together with ordinary cupola coke and ordinary pig-iron and scrap. The one result, if any, is that they improve a weak mixture in the most costly manner possible. An equally common phenomenon is to find foundries in one part of Great Britain buying their pig-iron from another, whilst those foundries in the latter district may be buying from the first. In the old days port wine was believed to improve by having travelled a long way, but the same reasoning cannot apply to pig-iron.

The price of a pig-iron is its cost as delivered to the foundry stockyard. A foundry having metallurgical aid can use those irons nearest to hand. If it desires to make high-duty irons, it can do so with the minimum of expenditure upon better-class irons. Let a foundry find out what it is spending upon expensive materials and upon freight on materials coming from further distances than necessary, and it will see what scientific control could save. The above are facts proved over and over again, and which should become known to all and applied by all for the good of the future of the industry.

The Necessity for Scientific Mixing.

A homely illustration is that one of giving an unskilled person some steak, kidney, flour, suet and flavouring materials and comparing the steak-and-kidney pudding with another made from precisely the same ingredients but by a skilful cook. Apply this to ironfoundry metallurgy. Given a high- and a low-silicon English or Scotch hematite, a high- and a low-silicon phosphoric pig-iron, some ferro-manganese, some steel scrap and scrap iron and, with those in the stockyard, it is possible to reproduce or to produce the cast iron made from any other English or Scotch irons, however costly. It may be that one day this will not hold good, but it is true to-day. Granted that it might, under special circumstances, be better for a foundry to reach the desired result by using more expensive materials, but such circumstances are very unusual. In any case, the best and most economical results from either cheap or expensive materials cannot be reached without knowledge, and nowhere is that more true than in ironfoundry metallurgy.

Ancient Metallurgy.

A long time ago—or so it seems—the author expounded certain rules relating to sulphur in cast iron, the work being based upon his deliberate raising of the sulphur until he reached a quantity of about 0.25 per cent., which gave some of the best cylinder-liner metals he had made. The rules became known as the sulphur-manganese balance, and he does not know of any further addition of useful practical importance to the knowledge upon this subject. Later he pointed out that low-carbon cast iron had great limitations. Time and time again he asked the powers that be to explain why low-carbon cast iron is not much stronger than higher-carbon iron. That great British research worker, Mr. Oliver Smalley, made cast iron containing nearly 4 per cent. of total carbon which was as strong as other iron containing about 3 per cent., yet the combined carbon content was no different. These are mysteries yet, and, unfortunately, we have no longer the agile brain of Mr. Smalley behind us.

Low-carbon cast iron is what the French would call "difficile"; it ranks with the high-sulphur and high-silicon irons in that respect. It possesses propensities difficult to control and undesirable to have to contend with under commercial conditions. In simpler language, it is not "worth while." Further, it is probable that a really good low-carbon cast iron would need a steel foundry rather than an ironfoundry.

Also there was the Perlit process. A Continental discovery and one which, to the author's mind, gave the greatest impetus to ironfoundry metallurgy seen in his lifetime. Since Perlit there would appear to have been a slump in invention. Although the author keeps a record of everything of commercial value to the ordinary foundry which comes to his notice, there seems to be nothing to comment upon. Cupolas have come and gone, and it looks as if cupolas always will be doing so. New methods of melting cast iron have been developed from the Continent and are highly interesting, but are not advanced sufficiently to enable one to say much for a certainty. Nor is it certain that they will interest the ordinary foundry. Special pig-irons have been evolved, but it would appear that when they are put into a cupola there is no reason to believe that the effects of the special treatment survive as far as the tap-hole. Nickel-containing irons have been the subject of much and commendable investigatory work. It would appear certain that nickel has its uses and that the labour undertaken was a step in the right direction so far as alloy irons are concerned. In straight irons (namely, not alloy irons) little or no progress can be reported.

Cast Iron Superseded by Steel.

Many foundries are making iron to resist abrasion or wear or corrosion or graphitisation or heat and using but the knowledge of old Perlit days, and not of the present Perlit days. The question of graphitisation of economiser plugs and pipes has been investigated by the author, and, could it be published, would form a Paper in itself. Whilst one hears the cries of those who say that cast iron is being superseded by steel, one is told little or nothing about the reasons why.

Dissolving Graphite in Molten Pig-Iron.

There is considerable talk to-day concerning the behaviour of the graphite of pig-iron when the iron becomes molten in the cupola and later when it solidifies and cools in the mould. This subject is neither as new nor as intricate as one might be led to believe by modern literature. This Paper will conclude, therefore, with an attempt to put into simple language the author's ideas about graphite and its ramifications. Addressing recently the London Junior Section, the author tried to explain this matter of graphite. From the discussion it was evident that some success had been attained, and, therefore, a similar simplicity of approach will be used here.

Graphite in pig-iron may be visualised as occurring like carraway seeds in a cake. Big seeds or little seeds—big flakes or little flakes—many or few. But it is not to be forgotten that the flakes of graphite in iron are, in reality, voids generally partially filled with graphite. Therefore, the percentage of graphite is no guide to either the number or the total or individual volume of the voids. Anyone reading these remarks should note that when the author refers to graphite flakes or specks, he is speaking of these voids. A little thought leads to the expectation that many foundry troubles coming under the heading of porosity, draw—or shrink—holes and so on, are directly or indirectly caused by localised or aggravated or abnormal manifestations of those phenomena by which the graphite flakes or voids come into being.

When pig-iron becomes molten the graphite flakes dissolve in the iron, the rate of dissolution being governed by all those conditions outlined later in the case of sugar and water. The dissolved graphite grows again in the cast iron in the mould, the manner and extent of the growing process depending upon the iron used and its behaviour under the particular cooling conditions of the mould.

Suppose instead of dissolving flakes of graphite in molten pig-iron, one imagines one is dissolving sugar as speedily as possible in so much water, and sum up the resultant knowledge thus:—(1) The hotter the water the more sugar will it dissolve; (2) the hotter the water the quicker will it dissolve any one amount of sugar; (3) the hotter the water the less trouble will there be to persuade the last specks of sugar to disappear; (4) the smaller the amount of sugar the quicker will it dissolve; (5) the smaller the amount of sugar the less necessity for very hot water; (6) the larger the lumps of sugar the slower will it dissolve; (7) the smaller the lumps or the finer the grains of sugar the less difficulty with the last specks; (8) some kinds of sugar take longer to dissolve than other kinds, this apart altogether from size; (9) when much sugar has already been dissolved in the water the more slowly can be persuaded yet more to dissolve in it, and the hotter will it be necessary to make the water if speed is important. Here, without use of difficult language, we get a good idea of what we are contending against when melting pig-iron and trying to get its flakes of graphite utterly dissolved before the iron enters the mould.

If, owing to the cupola practice or to the composition and structure of the pig-iron, the final specks of graphite—however infinitesimal—remain undissolved, then these specks act as

centres of irritation, as nuclei, as inductors, as starting-off points for the growth of graphite cooling in the mould. The result is that instead of obtaining a fine and well-distributed crop there would be a tendency towards larger plants —larger maybe in quantity, but certainly in individual magnitude. The matter also affects grain size (as determined by the phosphide or cementitic network). It does not appear possible to investigate these matters by means of separately-cast or cast-to-shape test-bars. Grain size and graphite size are physical considerations vitally concerning a casting having sudden changes of section, or where several sections meet, or where there are knobs on it, or when it is a very heavy or massive casting. There is a wealth of research work crying to be done on these important practical matters, and many hours could be directed to the discussion of what one has observed during years of practice. The subject is not new, only the discussion of it.

Importance of Pig-Iron Compositions.

Deep consideration shows that progress will depend upon the ability to understand the selection of correct pig-irons rather than upon cupola practice. A cupola is like a crucible having a hole in its bottom; no matter if the furnace is worked at its best the metal in that crucible will run out as soon as it becomes sufficiently fluid. Therefore, its temperature when it runs out depends upon how hot it needs to become before it runs. For example, a high-silicon phosphoric iron cannot be tapped from a cupola at as high temperature as can a low-silicon low-phosphorus iron. When selecting irons this point requires to be kept in mind.

As, therefore, one cannot heat any particular type of iron beyond a certain amount—in a cupola—one can proceed only to ensure that one obtains the best irons possible from that point of view, and also that they contain no excess graphite and no coarse or large graphite. This presupposes a long and wide experience of the accurate analyses of pig-iron and of the effects of composition upon physical structure. Unfortunately, as pointed out earlier in this Paper, few makers' published analyses are reliable, and, in as far as graphite and total carbon content are concerned, they are oft-times misleading. Carbon, silicon, phosphorus and manganese must be considered together. Manganese has a great affinity for carbon, with the result that in high-manganese materials not only is a double carbide present but also a very high carbon content, which latter is liable to be discharged as kish. For these two reasons much of the past work done upon the effects of manganese upon cast iron is rendered doubtful, because there is small evidence to show that the effects were not those of incompletely-dissociated double carbide rather than of manganese, while the risk of getting kish and graphite specks and large-growth graphite were left out of account altogether. Hence, while manganese increases the power of iron to dissolve carbon and so to avoid specks, if the added manganese-bearing compound is of the wrong kind, it has the opposite effects and the cast iron will have large graphite and much of it. Much the same remarks apply to chromium.

Concluding Remarks.

The whole of the subject of composition control could not be covered save by many Papers. Part has been introduced here with a view to showing that those in this country who love to follow the metallurgy of cast iron and of iron-foundry practice are yet in training whilst awaiting the long-delayed call to the old regiment of volunteer workers under voluntary leaders. Effort has been made to show how simple metallurgical economy and efficiency may be effected to-day in ordinary foundries, but it is to be considered with utmost gravity that the trade's emancipation to national sources of knowledge will become possible only when the majority of foundry owners are alert to the existence of the inertness into which general knowledge has fallen. The thought that genius and individual energy and ambition have departed from the workers employed in British foundries cannot be tolerated. Their oblivion is no fault of theirs. The tapping of those springs cost the industry nothing before the war. It is the only system under which young men may discover themselves and be discovered. Lastly, it will cost nothing again to grant the same welcome, the same status, together with equal publicity and support to all—to run open races and no handicaps and to appoint experienced and honorary judges who shall judge solely by results.

Turbo-Alternators of 50,000 KW.

(*Concluded from page* 363.)

The rotor is a single-piece solid steel forging. The rotor windings are insulated throughout with mica. The rotor is also fitted with heavy damping windings, which are connected to the end caps by means of a bonding device of special construction.

A closed air circuit ventilation system is provided for the alternators, the cooling air for each alternator being circulated by means of two half-capacity fans mounted inside the foundation block. The motors driving the fans are placed in an accessible position at the side of the blocks.

A number of other large plants are under construction at Heaton Works, including two 36,000-kw. turbo-alternators for the Municipal Lighting Department of the City of Copenhagen; an 18,750-kw. tandem turbo-alternator for the Lots Road Power Station of the London Electric Railway Company, and a 15,625-kw. 12,000-volt turbo alternator for Pretoria.

Vanadium in Steel Castings.

(*Concluded from page* 364.)

Significant advantages that predict important future applications will, however, be found in such steels in the chrome-vanadium, chrome-tungsten-vanadium and chrome-molybdenum-vanadium types, especially in respect to the combination of mechanical properties at normal and slightly elevated temperatures.

Conclusion.

Both engineers and steelmakers are apt to throw up their hands in horror at the mention of vanadium, on account of its high cost in comparison with some of the other alloy metals, due to its rarity and the difficult metallurgical operations needed to obtain the metal from its ores in a pure enough state for steelmakers' use. A brief calculation should suffice to explode this fallacy. The various steels containing vanadium of which the physical data are given above, contain round about 0.1 per cent. vanadium. This means on a ton of steel 2.24 lbs. vanadium, or, say, with losses, 2.5 lbs. The additional cost for this is about 30s. per ton of steel.

Corrosion of Buried Iron Pipes.—Messrs. K. H. Logan and V. A. Grodsky in a recent issue of the U.S. Bureau of Standards' "Journal of Research" report the results of examinations of about 1,300 specimens of ferrous pipe materials collected from 70 different localities. The extent of the corrosion was found, as was to be expected, to depend largely on the character of the soil in which the pipes were buried bare. At the same time it was also found that the rates of corrosion seemed to vary somewhat from year to year, but the general tendency was for the rate to decrease as the time of the exposure increased. On the whole the results did not indicate that there is a best pipe material regardless of soil conditions. The material which appears best in one soil may turn out inferior in another soil. It is too early to state whether this will hold true at the end of long-time tests. Supplementary tests indicate that a number of soils have characteristic corrosive properties.

Alloy Cast Irons.

(*Concluded from page* 365.)

Austenitic Cast Iron.

When the nickel content exceeds 20 per cent. the basis of the iron becomes completely austenitic, and its properties are quite different from those of ordinary cast iron. This austenitic basis can also be achieved by the alloying of nickel, copper and chromium to the basic grey iron. The product is known as "Nimol," and has the following approximate range of composition: T.C., 2.50 to 3.00; Si, 1.25 to 2.00; Mn, 1.00 to 1.50; S, 0.04 to 0.12; P, 0.04 to 0.30; Ni, 12.00 to 15.00; Cu, 5.00 to 7.00, and Cr, 1.50 to 4.00 per cent.

This austenitic iron has very good corrosion-resisting, heat-resisting and non-magnetic properties. Its tensile strength is about the same as that of ordinary cast iron, its elongation is measurable and is usually between 1½ and 2½ per cent. on 8 in., and it has the great advantage of a machinability equal to that of phosphor-bronze. It also retains a very good consistency of grain structure under varying rates of cooling, which is distinctly useful in castings of intricate design.

The heat-resisting qualities of the material will perhaps be appreciated from the following figures: A piece of ordinary cast iron and a piece of Nimol were raised to a temperature of 450 deg. C. for a period of 47 days, and subsequently to 600 deg. C. for 30 days. At the end of this time, the tensile strength of the ordinary iron had dropped from 14 tons per sq. in. to less than 9 tons, whereas the tensile strength of the Nimol (15 tons) was completely unaffected.

Again, similar test comparisons were made between ordinary iron and Nimol in superheated steam at a temperature of 900 deg. F. At the end of 1,300 hrs.' treatment, the percentage of volume increase of the ordinary iron was seven times greater than that of the Nimol.

Tests have also been carried out on the resistance to scaling of various irons when subjected to an oxidising atmosphere at 750 deg. C. The test-pieces were all of equal weight to begin with. At the end of 240 hrs.' continuous treatment, the following losses in weight were found to have taken place:—

Ordinary cast iron	97 grams.
Ni-chromium iron (containing 1 per cent. Ni and 0.35 per cent. Cr) ...	48 grams.
Ni-copper-chromium (Nimol) ...	9 grams.

In general, it can be said that Nimol will completely resist the ill-effects of temperatures up to 600 deg. C. Cases have been known where temperatures up to 850 deg. C. have had little effect, castings having given seven months' service at this temperature as against an average service of 7-10 days for ordinary cast iron.

An example of this is shown by a furnace perrit, which is used for carrying stove parts and baths in their enamelling furnaces. These castings in Nimol actually have an average life of nine months, compared with 4-7 days for ordinary cast iron. It is not claimed that these austenitic alloy irons are completely acid and corrosion resisting, but it has been proved on many occasions that they are very much better than ordinary irons. For instance, the author has carried out several tests at room temperature in a 5 per cent. aqueous solution of sulphuric acid. At the end of 100 hrs. the loss in weight of a piece of ordinary iron was almost exactly 100 times greater than the loss on the Nimol.

Similar results are obtained when the material is tested with an aqueous solution of hydrochloric acid, but it will not stand up to the effects of nitric acid. With this notable exception, however, it can be said that Nimol resists the action of all inorganic and organic acids to a very much greater degree than ordinary cast iron under the same conditions. This is also the case under atmospheric corrosion.

Testing Electrical Equipment in Foundries.

By "Kilowatt."

In order to keep a periodical check on the efficient operation of electrical plant, one employs various measuring instruments, such as ammeters, voltmeters and other recording appliances. Such precautions are deemed essential in every up-to-date electrically-driven foundry, but equally important is the provision for periodical testing, both with regard to the working efficiency of the motors and the insulation resistance of the circuits, so that any unsatisfactory condition thereby revealed may be remedied. No "leak," however small, should be ignored, as the saving of a small amount of current running to waste each day represents quite a considerable sum of money at the end of a year, as also unnecessary losses in any particular piece of apparatus. Such testing work demands a knowledge of facts, and these can only be ascertained by the use of accurate testing instruments.

The distributing system, which conveys the current from the switchboard to the various motors, is often responsible for current losses, and it is, therefore, a wise precaution to test periodically the insulation resistance of the whole cabling. To test for leakage, the proper instrument to use is the ohmmeter. There is a number of portable testing sets on the market, and perhaps the most common form is that known as the "Megger," in which a magneto, hand-driven generator provides the testing pressure, and a moving coil ohmmeter indicates the insulation resistance of the network as exposed to this voltage.

To test the insulation of a circuit the instrument is first placed on a steady base, and, in a circuit earth test, the line terminal is connected to the circuit and the earth terminal to a good earth. For testing between two wires, one wire is connected to each terminal of the instrument. The handle of the instrument is turned in a clockwise direction, and the testing generator develops its rated pressure when running at 100 r.p.m. of the driving handle. About half a dozen turns are sufficient to reach this speed, by which time the ohmmeter needle, which is quite dead beat, will have come to rest over the point on the scale indicating the insulation resistance to be determined.

It should be borne in mind that a minimum value of 1 megohm should be reached by the insulation resistance between either cable and "earth" or between one cable and another. Short lengths of cabling with few appliances connected to it would naturally be expected to show a better insulation resistance than longer runs of cabling with a large number of connections.

Motor Testing.

Coming to the motor, the question of testing for "leakage" is a somewhat difficult proposition. To establish the presence of a leak to earth is not a difficult matter, though reasonable care must be exercised in making the test. It has to be discovered whether there is a path by which current may flow from the armature windings to the frame of the machine. Such a test may be carried out by means of a galvanometer, voltmeter or lamp. While the last named is generally most handy, the fact must not be overlooked that a small leak which might be giving trouble need not be sufficient to cause a lamp to glow. One pole of the lamp should be firmly connected to the frame of the machine, and the latter run up to speed, while the lead from the second pole of the lamp must be brought into contact with first one and then the other set of brushes. Any leakage of the current to the frame would then be indicated by the glowing of the lamp, or, alternatively, the deflection of the galvanometer or the voltmeter.

Finding Leakages.

If by such a test a leak is recorded, the next question is to find it, and this is not always an easy matter, as there is a variety of paths for leaks. The first step on the path to earth is usually defective insulation on an armature coil or imperfect insulation of brush arms, commutator, etc. A path may be completed by copper dust between the end ring and a commutator segment, while it is quite possible for paint to be the culprit. On the other hand, oil may have soaked into the mica between the commutator bars and become solidified or charred, thus acting as a conductor.

Another form of leakage may be due to the armature coil actually making contact with its slot. The armature is the most complicated and delicate structure of the whole machine and naturally more liable to faults than the field coils, if only because of the increased stresses to which it is subjected. Vibration of loose coils, if any, will lead to chafing of the insulation, leakage, and eventually short circuits. A test for a short circuit between coils and iron core can be carried out by means of a galvanometer and a battery in series, one lead being placed on the armature shaft or core and the other on the commutator and moved round the sections.

Tests of motors and other equipment should be carried out, if possible, at a time that will represent average working conditions. This is a matter, of course, for the judgment of the engineer in charge of the plant, but care should be exercised against taking tests which will not produce the facts under average conditions. As to the frequency of such tests, this must depend on local conditions. Where the plant is in continual operation, monthly tests will be sufficient, provided weekly inspections are carried out.

Initial Testing.

Motors should be subjected to "load" tests when first installed, as also when the local conditions change, the latter in order to ascertain whether, in spite of changes in the plant, they are operating under conditions for which they are designed. In the case of motors operating under a steady load, only one test-reading is necessary, but where the load is intermittent sufficient time must be allowed in order to obtain a fair average reading. Load-testing of motors is of particular importance. Motors should be fully loaded in order that they may operate at maximum efficiency, and the determination of this load is arrived at by means of the ammeter and voltmeter. It is an easy matter to measure the input of a motor by simply measuring the power consumed, but to ascertain its actual h.p. output is a somewhat difficult problem. For this purpose it is necessary that the actual efficiency of the motor at the particular load where the measurements are made should be known; this is best obtained from the manufacturers.

One method of ascertaining the output of motors is by actual measurement at the motor pulley by means of a prony brake, which, in its simplest form, consists of a couple of wooden blocks clipped on the pulley or shaft transmitting the power to be indicated. Attached to the blocks is a lever, to which is attached a scale pan or a spring balance. If it is a direct-current machine an ammeter and voltmeter for measuring the energy applied and a tachometer, or speed counter, complete the apparatus required. In carrying out the test the motor is started and load applied; when it is steady, simultaneous readings are taken of the ammeter and voltmeter to measure the electrical energy given to the motor, also the weight on the brake arm, and the speed to determine the b.h.p. given out. By multiplying the ratio of the two readings by 100 the percentage efficiency of the motor is given.

In order to ascertain whether the motor is receiving its proper voltage, it is necessary to make an actual measurement by means of the voltmeter at the terminals of the apparatus. Such tests should be conducted when the plant is operated at full load, or as near thereto as possible. If variations from normal voltage are shown, it is necessary to determine where the increase or decrease takes place. Where the load or voltage fluctuates, the best method of testing is by means of a low-reading voltmeter with long leads for use between the various points to be measured. It is desirable that the instrument should have a double scale, so that a sufficient range is given on the higher scale to measure the highest operating voltage of the system.

Another method used for voltage-testing consists of the use of two voltmeters. One of these instruments is placed at the motor under test, while the other is moved along the cable to the switchboard, or other source of current; thus the drop in voltage between any desired points is determined.

Those in charge of the foundry plant should endeavour to organise this testing work on some definite system, so that all the electrical equipment in each room receives periodical attention. Each testing instrument should be allotted a card recording its last calibration, correction factor, and so on, while each motor should have a history card showing date of last test, readings taken, etc. Involving but little trouble, the keeping of such records is invaluable to both the engineer and management, and in the long run saves much time, as well as reducing expense.

The Fourth International Foundrymen's Congress.

PRELIMINARY ARRANGEMENTS.

At the last meeting of the French Foundrymen's Technical Association it was announced that the next International Foundry Congress would be held in Paris from September 14 to 17, 1932. It is proposed to stage two pre-convention tours, the first of which is primarily for the Americans. It takes in the foundries centred around Havre, Rouen and Caen. The second is for the British and Scandinavians, and includes visits to foundries in the North of France, Boulogne, Lille and Valenciennes. Both these tours will finish on Monday, September 12. On the evening of September 13 a social gathering will be held for the purpose of establishing contact between the various nationals.

The Congress will hold technical sessions every morning, whilst the afternoons will be devoted to visiting the Exhibition and Parisian foundries. Various receptions will be held. The official banquet, at which Mr. Andrew Harley, as President of the Foundrymen's International Technical Committee, will be principal guest, will be held on Saturday, September 17, and will be followed by a ball organised by the Paris Foundry High School Old Boys' Association. On the Sunday there will be an excursion, probably to Rambouillet.

Following the Congress, there are to be two Post-Convention Tours. The first will take in the Ardennes and Nancy and finish on Friday, September 23, whilst the second will include Bourges, Le Creusot, Lyon, Saint Etienne, Ugine, Grenoble, and will finish at Nice, travelling by the famous "route des Alpes."

Hints for Commercial Visitors to Chile.—The Department of Overseas Trade has issued a memorandum containing Hints for Commercial Visitors to Chile, prepared by the Commercial Secretary to the British Embassy at Santiago. Reference No. C.3,699.

This Week's News in Brief.

Trade Talk.

A blast furnace belonging to the Renishaw Iron Company, Limited, Chesterfield, was relighted recently.

Members of the staff of McDowall, Steven & Company, Limited, Laurieston Iron Works, Falkirk, held their annual whist drive and dance last Friday.

Messrs. R. Y. Pickering & Company, Limited, Wishaw, have received an order for twenty 32-seater omnibuses for the Lanarkshire Traction Company's motor services.

Messrs. Leigh & Sillavan, Limited, have changed the address of their London office to Victoria House, Vernon Place, Southampton Row, W.C.1. The telephone number and telegraphic address are unchanged.

Employees of the Argus Foundry Company, Limited, Thornliebank, have allocated the sum of £44 to infirmaries and charitable institutions. Employees of the Burntisland Shipyard have subscribed £56 towards the hospital fund.

Lithgows, Limited, Port Glasgow, have received an order for a cargo steamer of 6,500 tons from H. Hogarth & Sons, Limited, Glasgow. Messrs. Lithgows have also received an order from Kaye, Son & Company, Limited, London, for a vessel of approximately 5,000 tons gross. This is the eighth vessel which the company has secured since August.

A contract for 105,000 steel sleepers is to be placed shortly by the Great Western Railway Company, carrying out the decision of the company to include in their 1932 relaying programme the laying of approximately 50 miles of track with steel sleepers. In addition, the company will by the end of this year have short lengths equivalent to 94 miles of track so equipped.

The Fletcher balanced-blast cupola can be obtained by members of the B.C.I.R.A. from Alldays & Onions, Limited, Birmingham; Constructional Engineering Company, Limited, Birmingham; Geo. Green & Company, Keighley; the Horsehay Company, Limited, Wellington, Shropshire; J. W. Jackman & Company, Limited, Manchester; and Pneulec, Limited, Smethwick.

The Levenseat Sand & Lime Company, belonging to Messrs. T. & J. Thornton, at West Calder, has been acquired by General Refractories, Limited, of Sheffield. The sand is of very high quality, and eminently suitable for iron moulding. The works have connections with the L.M.S. and L.N.E. Railways, and General Refractories, Limited, anticipate making important developments.

Messrs. Furness, Withy & Company, Limited, have placed with Messrs. Vickers-Armstrongs, Limited, an order for a 20,500-ton liner, similar to the "Monarch of Bermuda," and she will be built at Barrow. The "Monarch of Bermuda" was built at Vickers-Armstrongs' yard at Walker-on-Tyne. She will replace the "Bermuda," recently destroyed by fire at Belfast.

The Standing Committee appointed by the Board of Trade under the Merchandise Marks Act to consider the question of imported iron or steel flush pipes reports that it has come to the conclusion that a Marking Order should be made. It does not consider that a sufficient case was made out for the making of an importation Order, but recommends that imported flush pipes should be required to bear an indication of origin on sale or exposure for sale.

Messrs. S. P. Austin & Son, Limited, Sunderland, are to build two 2,000-ton colliers for the London Power Company, for whom Messrs. Stephenson Clarke & Associated Companies, Limited, are managing owners. The vessels will be engined by Messrs. John Dickinson & Sons, Limited, Sunderland. Two other vessels of the same type—for carrying coal to the new power station at Battersea—are to be built for the same owners by the Burntisland Shipbuilding Company, Limited.

The shareholders of Messrs. R. & W. Hawthorn, Leslie & Company, Limited, shipbuilders and engineers, Newcastle, have sanctioned the reduction of the issued and fully-paid ordinary shares of £1 each to 10s. each by the return of 10s. per share to shareholders. The authorised capital remains unchanged. The actual ordinary issued capital, fully paid, of 716,550 £1 shares becomes 716,550 shares of 10s., but 716,550 new ordinary shares of 10s. each are to be created. An arrangement with the debenture holders to increase the rate of interest from 4½ per cent. to 5 per cent. has also been sanctioned.

It is announced by Messrs. Alfred Herbert, Limited, Coventry, that they have purchased the whole of the assets of Swift (of Coventry), Limited, with the exception of the land and buildings, and have disposed of the goodwill, name, jigs, tools, drawings and finished and unfinished spare parts to Messrs. R. H. Collier & Company, Limited, South Yardley, Birmingham. The existing plant, comprising 500 capstan and turret lathes, drilling machines, milling machines, gear cutters, grinders, automatic screwing and chucking machines and woodworking machines, will be offered for sale piecemeal by Messrs. Alfred Herbert, Limited.

Proposals for winding up the existing company and forming a new one are before the shareholders of Messrs. Samuel Osborn & Company, Limited, Clyde Steelworks, Sheffield. This step is proposed instead of endeavouring to reduce the capital of the company. Mr. W. F. Osborn (the chairman), in an official statement, points out that from the balance-sheet, as at July 31 last, it will be seen that, notwithstanding the fact that the year's profits did not warrant a dividend being paid on the ordinary shares, the company is in a very strong position with its gilt-edged and other investments, without a debenture or charge on any of its assets, and has, in fact, for some years past had more liquid resources than are necessary for normal trading purposes. The directors, therefore, have been contemplating the possibility of using part of these liquid resources to pay off some of the existing capital of the company. The 5½ per cent. tax-free preference shares were issued soon after the war, when interest rates were high, and, it is claimed that for a company with their stability, record and resources such a standing rate at the present time is excessive. The directors are advised that, instead of reducing the capital of the company, the simplest and best method of dealing with the matter is to wind up the existing company and form a new one with the same name. It is proposed that the new company should acquire the assets of the old company, the shares in the latter company being paid off at par. One ordinary share of £1 in the new company would then be issued for each ordinary share in the old company. In regard to preference shares, (*a*) 5s. in cash would be paid to each preference shareholder in respect of each preference share held in the old company; (*b*) three 5½ per cent. £1 preference shares cumulative up to 5½ per cent., less tax, but with participation in the company's profits with the ordinary shares up to 7½ per cent., in the new company would be issued for every four preference shares held in the old company; (*c*) fractions of new shares would be disregarded and the amount adjusted in the cash payment. It is considered that the repayment, at par, of part of their capital will be of advantage to shareholders at the present time. This will also automatically increase the security for the new preference issue, which will be smaller in total and require less for the annual dividend.

Personal.

Mr. A. A. Timmins, a junior member of the staff of the British Cast Iron Research Association, has been awarded the Bronze Medal of the Birmingham Metallurgical Society for a Paper he presented thereto.

Mr. Montubet, foundry owner, of Nogent sur Oise, who is well known internationally, has been decorated by the French Government with the Order of the Legion of Honour, which he enters as a chevalier.

Mr. L. W. Bolton, metallographist to the British Cast Iron Research Association, has been awarded a Carnegie Scholarship, valued at £100, by the Iron and Steel Institute for the purposes of studying the transverse strength of cast iron at high temperatures.

Obituary.

Mr. William Lee Matthews, a director of Messrs. Thomas Bolton & Sons, Limited, copper refiners and brassfounders, of Widnes, died in the South of France last week in his seventieth year.

Mr. Robert C. Crawford, President of the Atlas Foundry Company, Detroit, and a native of Glasgow, died last month at the age of 58 years. He went to the States in 1902, and became President of the Atlas Company in 1916.

Sir John Pearce Luke, for several years President of the New Zealand Ironmasters' Association, died suddenly on Monday, at the age of 73. Born in England, he went out to New Zealand when 16 years of age, and for 35 years he carried on business with his late father and brothers as mechanical and marine engineers. He took an active part in promoting the industry of the Dominion, and was for many years President of the New Zealand Industrial Association. He was knighted in 1921.

Sir Archibald McInnes Shaw, C.B., D.L., J.P., V.D., died suddenly at a Glasgow nursing home on December 4. Sir Archibald was born in Maryhill, Glasgow, in 1862, and after receiving his education at Glasgow Academy, entered the firm of Shaw & McInnes, Firhill Iron Works, Glasgow, which was founded by his father and uncle. He subsequently became the sole partner of the business, which expanded very largely under his management, another foundry being acquired later in Scotstoun. Sir Archibald, after some years' service in the Town Council, became Lord Provost of Glasgow in 1908. During his term of office a number of notable events in the life of the city occurred, including extension schemes, in which he took a prominent part. In 1911 he officially represented the city at the coronation of King George. A great many organisations claimed Sir Archibald as a member and active supporter, including the Incorporations of Hammermen and Wrights, the Royal Clyde Yacht Club, the Perthshire Association, the Fife, Kinross and Clackmannan Association and the Dumbartonshire Association. He was a director of numerous concerns, and a Past-President of the Greensand Pipe Founders' Association, of the Scottish Employers' Federation and the Iron and Steel Founders' Association. He was much interested in the Institute of British Foundrymen and rendered many valuable services to the Scottish Branch during the 21 years of its existence. As a permanent record of these services, the Scottish Branch, in connection with its coming-of-age celebrations in April of this year, founded the Sir Archibald McInnes Shaw Prize for students of the foundry classes held under the auspices of the Corporation of Glasgow.

Book Review.

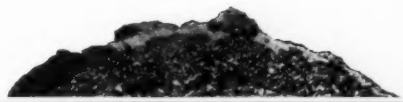
(*Concluded from page* 358.)

history of alloy steels; (VII) the investigation of Faraday's "Steel and Alloys"; (VIII) an appreciation of the master's work: (IX) describes the later developments of alloy steels; (X) serves as the concluding chapter. The appendices consist of (1) a list of papers, books and letters relating to metallurgical matters in which the older savants were interested, and (2) a table of physical constants relating to the elements employed in Faraday's "Steel and Alloys."

Quite apart from the historical value of the volume, the work contains much information of scientific and technical interest, and "Faraday and his Metallurgical Researches" may well be added to the shelves of every library. It is an open secret that the proceeds of the sale of Sir Robert's book are to be devoted to the funds of the Royal Institution, to be used for the furtherance of the science of metallurgy. Sir Robert's generosity in this respect is but another evidence of the reviewer's conclusion that the writing of the book has been a veritable labour of love.

W. L.

The steamer "Liberty," belonging to the L.M.S. Railway, has been sold to Mr. Thomas Young, Sunderland, for breaking up.



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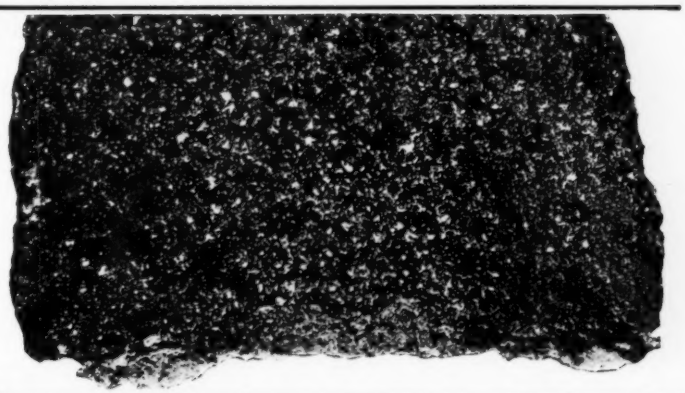

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AND MANY OTHERS IN SOUTHERN ENGLAND

Raw Material Markets.

Business in the iron and steel markets during the past week has been dull, the majority of consumers having already engaged in forward contracts. Hence new orders are mostly of small proportions. Such conditions, it may be noted, are to be expected during the last few weeks of the year. The export market is quiet, but has been helped somewhat by the lower value of the pound sterling.

Since the passing of the Abnormal Importations Act there has been continual pressure on the President of the Board of Trade to place a tariff on imported iron, but, in view of his statements in the Commons, it seems that no steps will be taken at present.

Pig-Iron.

MIDDLESBROUGH.—There has been no expansion in the demand for pig-iron in the Cleveland area, and the ironmasters seem content to await developments, the majority of them having already disposed of their December output. Most of the sales reported are only for small quantities, although several good contracts have been fixed for January/February delivery. It is felt that a tariff on foreign pig-iron, if such a measure emerges from the present discussions, would materially aid the sale of Cleveland iron in Scotland. Prices are as follow:—No. 3 Cleveland G.M.B., 58s. 6d.; No. 1 foundry, 61s.; No. 4 foundry, 57s. 6d.; No. 4 forge iron, 57s. per ton.

Sales of East Coast hematite iron are not so satisfactory, and little new business is being done. Good deliveries, however, are being taken on contract account, and several small export orders have been secured. The price of East Coast mixed numbers is steady at 65s. per ton.

LANCASHIRE.—There have been few new orders for foundry iron in this area, but contract deliveries are fully taken. It was reported on the Manchester Royal Exchange that Indian brands of foundry iron had reappeared, and were being offered at about 77s. 6d. per ton, delivered over the first three months of 1932. Quotations are maintained, with Midland foundry makes on offer for delivery to users in the Manchester price zone at 67s. per ton, North-East Coast at 67s., Northamptonshire at 65s. 6d., Derbyshire forge iron at 62s., Scottish pig-iron at from 86s. 6d. to 87s. and West Coast hematite at about 81s.

MIDLANDS.—In this area also, new business is of less importance than contract deliveries, which are being well taken. The "heavy" consumers are still in an unsatisfactory position. A meeting of pig-iron producers has been held, but it was decided to make no change in prices. For delivery to Birmingham and Black Country stations, makers continue to quote 62s. 6d. for Northants No. 3 and 66s. for Derbyshire, North Staffordshire and Lincolnshire No. 3.

SCOTLAND.—The Scottish pig-iron market is dull and featureless, most consumers having contracted for their requirements for several months ahead. Scottish No. 3 foundry iron remains at 69s. 6d. f.o.t. furnaces, with 2s. 6d. extra for No. 1, and Cleveland No. 3 continues at 61s. 6d. at Grangemouth.

Coke.

The coke market remains steady. The home demand is moderate, producers of best makes being well contracted to the end of the year. In the Doncaster district blast-furnace coke for inland is quoted at around 12s. per ton on rail at makers' works, and for shipment 17s. to 18s. per ton f.o.b. Humber ports. Foundry coke, f.o.b. Newcastle, averages 16s. 9d. and furnace coke, delivered Middlesbrough, is also quoted at 16s. 9d.

Steel.

Little new business is passing in the finished-steel market. To ensure regularity of working many more orders are needed. Some of the lighter trades are experiencing a better demand, but the shipbuilding and constructional engineering industries are not taking large tonnages. The black-sheet trade is meeting with a fair amount of business. In the semi-finished steel market the buying of semis is mainly confined to small lots. Practically no Continental semi-finished steel has been bought, the fluctuations of the exchange making business almost impossible.

Scrap.

In the Cleveland iron and steel scrap market prices have been maintained, although the tone of the market is not quite so confident. Consumers are inclined to limit their purchases to their present needs. For heavy steel scrap 42s. 6d. is still offered as a delivered price, while machinery cast iron is at 47s. 6d. There is still a good demand in the Midlands. Heavy steel scrap is maintained at 37s. 6d. and 40s. is quoted for light cast iron. In South Wales the demand for scrap is fair, but supplies are more plentiful. Heavy steel scrap in furnace sizes remains at 47s. 6d. Scrap prices are maintained in Scotland. The demand is good, and supplies are not so plentiful, but unfortunately the steelworks and ironworks are not getting as many orders for finished material as was anticipated.

Metals.

Copper.—On comparing day-to-day prices with the fluctuations of sterling, it will be seen that the strength of the pound is the dominant feature in the market. The demand from consumers is quiet, but there has been considerable speculative buying and selling of standard metal. With regard to the position of the producers, numerous conferences have been held, on both sides of the Atlantic, but the future is too uncertain to enable any forecast to be made.

Closing quotations:—

Cash.—Thursday, £36 12s. 6d. to £36 15s.; Friday, £36 13s. 9d. to £36 15s.; Monday, £38 to £38 2s. 6d.; Tuesday, £38 10s. to £38 12s. 6d.; Wednesday, £38 to £38 2s. 6d.

Three Months.—Thursday, £37 5s. to £37 7s. 6d.; Friday, £37 6s. 3d. to £37 7s. 6d.; Monday, £38 12s. 6d. to £38 15s.; Tuesday, £39 2s. 6d. to £39 3s. 9d.; Wednesday, £38 12s. 6d. to £38 15s.

Tin.—There has not been much business with consumers during the past week. The outlook remains uncertain, but it is hoped that, with the further restriction of output coming into force in January, and with the expected New Year improvement in industry, there will be an increase in consumers' demand.

Official closing prices:—

Cash.—Thursday, £136 10s. to £136 12s. 6d.; Friday, £136 7s. 6d. to £136 10s.; Monday, £138 2s. 6d. to £138 5s.; Tuesday, £138 5s. to £138 7s. 6d.; Wednesday, £137 5s. to £137 7s. 6d.

Three Months.—Thursday, £139 7s. 6d. to £139 10s.; Friday, £139 5s. to £139 7s. 6d.; Monday, £141 to £141 5s.; Tuesday, £141 2s. 6d. to £141 5s.; Wednesday, £140 2s. 6d. to £140 5s.

Spelter.—There has not been much support from consumers, the galvanising trades being quiet, but it is felt that the vigorous control of production will prevent any fall in price. Recent price fluctuations can be accredited to the influence of the foreign exchange.

Daily fluctuations:—

Ordinary.—Thursday, £14 18s. 9d.; Friday, £14 7s. 6d.; Monday, £14 10s.; Tuesday, £14 10s.; Wednesday, £14 3s. 9d.

Lead.—Most of the works in England are covered to the end of the year, accounting for the present falling-off in buying, but the market is steady, as arrivals in this country have been adjusted to the lower demand.

The week's prices have been:—

Soft Foreign (Prompt).—Thursday, £15 1s. 3d.; Friday, £15 1s. 3d.; Monday, £15 6s. 3d.; Tuesday, £15 10s.; Wednesday, £15 2s. 6d.

New Companies.

J. C. Dalmain & Sons, Limited, Chunk Foundry, River Street, Birmingham.—Capital £2,000. Iron and brass founders. Directors: J. H. Dalman and H. C. Sargent.

Midland Metal Diecasting, Limited, Fort Works, Pelham Street, Wolverhampton.—Capital £2,000. Directors: A. Ratcliffe, F. F. Sharpe, F. P. Webster and J. M. Wyer.

Jardine Whyte & Company, Limited.—Capital £1,000. Engineers and founders. Directors: Jardine Whyte, 4, Cumberland Terrace, London, N.W.; and A. E. Illingworth.

E. Potterton & Son, Limited, 60, Henry Street, Birmingham.—Capital £6,000. Engineers and brass-founders. Directors: Mrs. H. E. Potterton, A. Benton and J. W. Potterton.

Griffiths, Richardson & Company, Limited.—Capital £100. Ironfounders and mechanical engineers. Directors: B. M. Noel, Doreen I. Newman. Solicitors: Kenneth Brown, Baker, Baker, Essex House, Essex Street, London, W.C.

Contracts Open.

Baldoyle, Ireland, December 15.—Providing and laying water mains, for the Dublin Board of Public Health. Mr. F. P. Russell, engineer, 15, Parnell Square, Dublin. (Fee £3 3s., returnable.)

Hartley Wintney, Hants, December 17.—Providing and laying 330 yds. of 6 in. cast-iron sewer and 300 yds. of 4 in. rising main, for the Rural District Council. Mr. G. Swayne, 1, Victoria Street, Westminster, S.W.1. (Fee £3 3s., returnable.)

Plymouth, December 14.—1,500 yds. 6 in., 300 yds. 3 in., 120 yds. 12 in. cast-iron or spun pipes, for the Corporation. Mr. F. Howarth, water engineer, Stonehouse Town Hall, Plymouth.

Reports and Dividends.

Aston Construction Company, Limited.—Net profit, £1,149; brought in, £7,922; preference dividend, £1,050; no payment on the ordinary shares; carried forward, £8,021.

Dorman, Long & Company, Limited.—Profit, £30,445; transferred from reserve, £242,641; brought in, £174,953; available, £448,039; debenture interest, £306,187; loss on exchange, £129,677; carried forward, £10,375.

Hepworth & Grandage, Limited.—Net profit, £21,336; brought in, £1,712; directors' fees, £1,443; tax, £1,737; final dividend of 5 per cent., making 10 per cent.; to reserve, £5,000; carried forward, £2,367.

Petters, Limited.—The directors have decided to defer consideration of the payment of an interim dividend on the preference shares for three months.

Scientific and Technical Abstracts.—A conference on scientific abstracting service was recently held at the Imperial College of Science and Technology at the invitation of Mr. H. T. Tizard, president of the Association of Special Libraries and Information Bureaux. The object of the meeting was to exchange experience and to discuss methods, not with a view to advocating standardisation, but in order to produce a body of information which could be utilised to mutual advantage. The conference unanimously approved of collecting and reporting on the methods employed by Societies and Industrial Undertakings for collecting and reviewing foreign publications. A small committee was appointed to issue a *Questionnaire* to Abstract Organisations and Information Bureaux, and to summarise their replies. One of the main objects is to try to provide a more complete and prompt review of foreign scientific and technical publications, especially in the less understood languages, as, *e.g.*, Russian, Japanese, etc. The committee will attempt to indicate precisely what methods have been found successful or ineffective, and to analyse the collected experience and opinions. Copies of the *questionnaire* may be obtained from Mr. S. S. Bullock, Secretary of the Association, 16, Russell Square, London, W.C.1.

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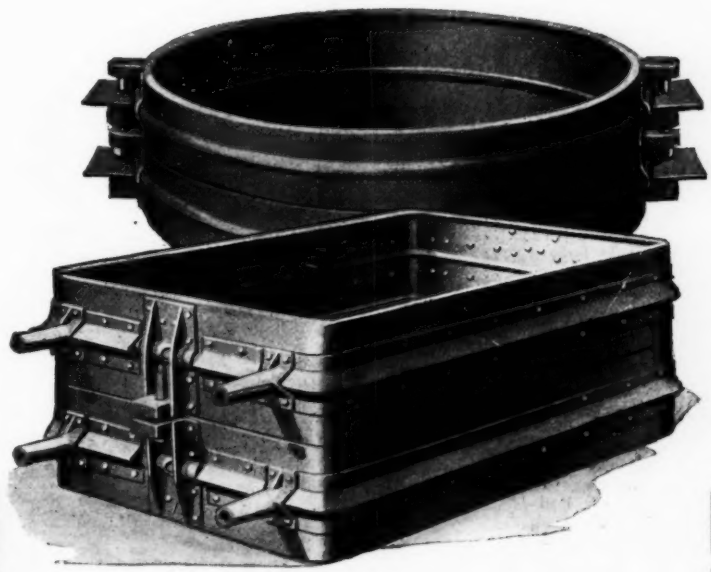
To give you the advantages of both price and quality that result from standardised production, Sterling boxes are made in thirty standard designs. Notwithstanding this, our technical staff are constantly engaged in designing boxes for special purposes, embodying those important Sterling features — Lightness, Strength, Rigidity and Accuracy. Thus the final product of England's largest Foundry Equipment Works offer the nearest approach to perfection that technical skill can economically provide.



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WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	38	0	0
Three months	38	12	6
Electrolytic	43	0	0
Tough	39	10	0
Best selected	39	15	0
Sheets	75	0	0
India	52	10	0
Wire bars	48	5	0
Do., January	48	5	0
Do., February	48	5	0
Ingot bars	48	5	0
H.C. wire rods	49	0	0
Off. av. cash, Nov.	35	18	1½
Do., 3 mths., Nov.	36	9	10 7/12
Do., Sttlmnt., Nov.	35	17	11½
Do., Electro, Nov.	42	1	2½
Do., B.S., Nov.	38	3	1½
Do., wire bars, Nov.	42	18	6½
Solid drawn tubes			11d.
Brazed tubes			11d.
Wire			7½d.

BRASS.

Solid drawn tubes	10d.
Brazed tubes	12d.
Rods, drawn	8⅞d.
Rods, extd. or rlld.	5½d.
Sheets to 10 w.g.	8⅜d.
Wire	8⅜d.
Rolled metal	7⅞d.
Yellow metal rods	5½d.
Do. 4 × 4 Squares	6½d.
Do. 4 × 3 Sheets	6½d.

TIN.

	£	s.	d.
Standard cash	137	5	0
Three months	140	2	6
English	139	0	0
Bars	141	5	0
Straits	140	17	6
Australian	139	10	0
Eastern	143	12	6
Banca (nom.)	152	5	0
Off. av. cash, Nov.	132	18	10⅞
Do., 3 mths., Nov.	135	2	6
Do., Sttlmt., Nov.	132	17	10⅞

SPELTER.

	£	s.	d.
Ordinary	14	3	9
Remelted	13	5	0
Hard	11	10	0
Electro 99.9	16	15	0
English	15	5	0
India	13	10	0
Zinc dust	23	0	0
Zinc ashes	3	15	0
Off. aver., Nov.	14	0	10 5/16
Aver. spot, Nov.	13	16	10⅝

LEAD.

	£	s.	d.
Soft foreign ppt.	15	2	6
English	16	15	0
Off. average, Nov.	14	10	8 3/16
Average spot, Nov.	14	11	6⅞

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	24	10	0
Do., V.M. ex-whf.	27	0	0
Rods	32	0	0
Boiler plates			—
Battery plates			—

ANTIMONY.

	£	s.	d.
Special brand, Eng.	40	0	0
Chinese	29	0	0
Crude	20	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver (nom.)	20	15	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	£6 12 6
45/50%	£9 10 0
75%	£15 0 0
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% c. free, nominal	
Ferro-titanium—	
23/25% carbon-free	11½d. lb.
Ferro-phosphorus, 20/25%	£16 15 0
Ferro-tungsten—	
80/85%	1/8½ lb. plus 20%
Tungsten metal powder—	
98/99%	1/11½ lb. plus 20%
Ferro-chrome—	
2/4% car.	£34 0 0
4/6% car.	£25 0 0
6/8% car.	£24 0 0
8/10% car.	£22 10 0
Ferro-chrome—	
Max. 2% car.	£36 0 0
Max. 1% car.	£40 0 0
Max. 0.70% car.	£51 0 0
70% carbon-free	11d. lb.
Nickel—99% (nom.)	£250 to £255
Ferro-cobalt	8/6 lb.
Aluminium 98/99%	£95 0 0
Metallic chromium—	
96/98%	3/- lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export (nom.)	£ 9 0 0
Metallic manganese—	
94/96% carbon-free	1/6 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 7/32 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£	s.	d.	£	s.	d.
South Wales—						
Heavy steel				2	7	6
Bundled steel and shrngs.	1	17	6	to 2	6	6
Mixed iron and steel	2	2	6	to 2	3	6
Heavy cast iron	2	7	0	to 2	8	0
Good machinery for foundries	2	12	6	to 2	15	0
Cleveland—						
Heavy steel				2	2	6
Steel turnings				1	12	6
Cast-iron borings				1	6	0
Heavy forge				3	2	6
W.I. piling scrap				2	15	0
Cast-iron scrap	2	5	6	to 2	7	6
Midlands—						
Light cast-iron scrap				2	0	0
Heavy wrought				2	15	0
Steel turnings, f.o.r.				1	2	6
Scotland—						
Heavy steel				2	2	6
Ordinary cast iron				2	7	6
Engineers' turnings				1	10	0
Cast-iron borings				1	12	0
Wrought-iron piling				2	7	6
Heavy machinery				2	17	0

London—Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	32	0	0
Brass	24	0	0
Lead (less usual draft)	13	0	0
Tea lead	10	0	0
Zinc	7	15	0
New aluminium cuttings	62	0	0
Braziery copper	30	0	0
Gunmetal	28	0	0
Hollow pewter	90	0	0
Shaped black pewter	70	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	61/-
Foundry No. 3	58/6
Foundry No. 4	57/6
Forge No. 4	57/-
Hematite No. 1	65/6
Hematite M/Nos.	65/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	73/-
,, d/d Birm.	84/6
Malleable iron d/d Birm.	117/6
Midlands—	
Staffs common*	—
,, No. 4 forge*	61/-
,, No. 3 fdry.*	66/-
Shrops basic	—
,, Cold blast, ord.	—
,, ,, roll iron	—
Northants forge*	57/6
,, fdry. No. 3*	62/6
,, fdry. No. 1*	65/6
Derbyshire forge*	61/-
,, fdry. No. 3*	66/-
,, fdry. No. 1*	69/-
,, basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	72/-
,, No. 3	69/6
Hem. M/Nos. d/d	68/6
Sheffield (d/d district)—	
Derby forge	58/6
,, fdry. No. 3	63/6
Lincs forge	—
,, fdry. No. 3	63/6
E.C. hematite	76/-
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby forge	62/-
,, fdry. No. 3	67/-
Staffs fdry. No. 3	67/-
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	86/6 to 87/-
Clyde, No. 3	86/6 to 87/-
Monkland, No. 3	86/6 to 87/-
Summerlee, No. 3	86/6 to 87/-
Eglinton, No. 3	86/6 to 87/-
Gartsherrie, No. 3	86/6 to 87/-
Shotts, No. 3	86/6 to 87/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

	£	s.	d.	£	s.	d.
Iron—						
Bars (cr.)	9	15	0	to 10	5	0
Nut and bolt iron	8	7	6	to 8	12	6
Hoops	10	10	0	to 12	0	0
Marked bars (Staffs) f.o.t.				12	0	0
Gas strip	10	10	0	to 12	0	0
Bolts and nuts, ¾ in. × 4 in.				12	10	0
Steel—						
Plates, ship, etc.	8	15	0	to 8	17	6
Boiler plts.	8	15	0	to 9	15	0
Chequer plts.				10	7	6
Angles				8	7	6
Tees				9	7	6
Joists				8	15	0
Rounds and squares, 3 in. to 5½ in.				9	7	6
Rounds under 3 in. to ¾ in. (Untested)				6	17	6 & up.
Flats—8 in. wide and over				8	12	6
,, under 8 in. and over 5 in.				8	17	6
Rails, heavy	8	5	0	to 8	10	0
Fishplates				12	0	0
Hoops (Staffs)				9	10	0
Black sheets, 24g.	8	5	0	to 9	5	0
Galv. cor. shts.	9	0	0	to 9	10	0
Galv. flat sheets	9	10	0	to 10	0	0
Galv. fencing wire, 8g. plain					—	
Billets, soft	5	7	6	to 5	12	6
Billets, hard				6	12	6
Sheet bars	5	0	0	to 5	10	0
Tin bars				5	0	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	11¼d.
Sheet to 10 w.g.	12½d.
Wire	12½d.
Rods	11¼d.
Tubes	17d.
Castings	13d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
5% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	15.51
No. 2 foundry, Valley	16.00
No. 2 foundry, Birm.	12.00
Basic	16.76
Bessemer	18.26
Malleable	18.26
Grey forge	17.76
Ferro-mang. 80%	85.00
O.-h. rails, h'y, at mill	43.00
Billets	29.00
Sheet bars	29.00
Wire rods	35.00
	Cents.
Iron bars, Phila.	2.09
Steel bars	1.60
Tank plates	1.60
Beams, etc.	1.60
Skelp, grooved steel	1.60
Skelp, sheared steel	1.60
Steel hoops	1.80
Sheets, black, No. 24	2.40
Sheets, galv., No. 24	2.90
Wire nails	1.90
Plain wire	2.20
Barbed wire, galv.	2.55
Tinplates, 100-lb. box	$4.75

COKE (at ovens).

Welsh foundry	22/6 to 25/-
,, furnace	16/6 to 17/6
Durham and Northumberland—	
,, foundry	15/- to 15/6
,, furnace	15/-
Midlands, foundry	—
,, furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box		13/6 to 13/9
,,	28×20 ,,		27/- to 27/6
,,	20×10 ,,		20/-
,,	18¾×14 ,,		14/6
C.W.	20×14 ,,		12/6 to 13/-
,,	28×20 ,,		25/3
,,	20×10 ,,		19/4½
,,	18¾×14 ,,		13/9

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6	0	0	to £7	0	0
Bars, hammered, basis	£16	10	0	to £17	0	0
Bars and nail-rods, rolled, basis	£15	17	6	to £16	5	0
Blooms	£10	0	0	to £12	0	0
Keg steel	£32	0	0	to £33	0	0
Faggot steel	£18	0	0	to £23	0	0
Bars and rods dead soft, st'l	£10	0	0	to £12	0	0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

TUBES AND FITTINGS.

Current Discounts.

	Tubes.	*Fittings.*
Gas	62½%	57½%
Water ..	58½%	52½%
Steam ..	55%	47½%

W.I. 12½% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.		
Dec.	3 ..	36	12	6	dec.	15/-
,,	4 ..	36	13	9	inc.	1/3
,,	7 ..	38	0	0	,,	26/3
,,	8 ..	38	10	0	,,	10/-
,,	9 ..	38	0	0	dec.	10/-

Electrolytic Copper.

		£	s.	d.		
Dec.	3 ..	42	0	0	dec.	20/-
,,	4 ..	42	0	0	No change	
,,	7 ..	43	0	0	inc.	20/-
,,	8 ..	43	0	0	No change	
,,	9 ..	43	0	0	,,	,,

Standard Tin (cash).

		£	s.	d.		
Dec.	3 ..	136	10	0	dec.	15/-
,,	4 ..	136	7	6	,,	2/6
,,	7 ..	138	2	6	inc.	15/-
,,	8 ..	138	5	0	,,	2/6
,,	9 ..	137	5	0	dec.	20/-

Tin (English ingots).

		£	s.	d.		
Dec.	3 ..	138	0	0	dec.	15/-
,,	4 ..	138	0	0	No change	
,,	7 ..	139	15	0	inc.	35/-
,,	8 ..	139	15	0	No change	
,,	9 ..	139	0	0	dec.	15/-

Zinc Sheets (English).

		£	s.	d.		
Dec.	3 ..	24	10	0	No change	
,,	4 ..	24	10	0	,,	,,
,,	7 ..	24	10	0	,,	,,
,,	8 ..	24	10	0	,,	,,
,,	9 ..	24	10	0	,,	,,

Spelter (ordinary).

		£	s.	d.		
Dec.	3 ..	14	8	9	inc.	1/3
,,	4 ..	14	7	6	dec.	1/3
,,	7 ..	14	10	0	inc.	2/6
,,	8 ..	14	10	0	No change	
,,	9 ..	14	3	9	dec.	6/3

Lead (English).

		£	s.	d.		
Dec.	3 ..	16	10	0	No change	
,,	4 ..	16	10	0	,,	,,
,,	7 ..	16	10	0	,,	,,
,,	8 ..	17	0	0	inc.	10/-
,,	9 ..	16	15	0	dec.	5/-

AVERAGE MONTHLY PRICES OF CLEVELAND No. 3 PIG-IRON.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1887	37 5	35 10	34 4	34 4	34 1	34 10	34 4	34 5	33 9	31 10	31 8	33 6	34 2
1888	32 2	31 1	31 5	31 9	30 11	31 5	32 4	33 5	34 8	34 2	33 1	33 10	32 7
1889	33 8	35 0	37 5	38 9	38 6	37 10	40 1	43 4	44 1	51 5	64 7	61 1	43 10
1890	60 3	53 1	51 0	47 4	42 2	41 5	43 2	45 7	47 9	47 10	47 4	43 1	47 6
1891	42 1	41 10	39 9	38 7	40 9	41 0	40 8	39 8	40 4	39 11	38 8	38 1	40 1
1892	37 7	35 7	36 10	37 10	39 2	40 11	39 11	39 10	40 0	38 6	37 6	37 4	38 5
1893	36 0	34 3	34 4	34 2	33 10	34 8	35 3	35 5	35 4	34 8	34 7	35 9	34 10
1894	35 8	35 11	36 1	36 1	35 5	35 5	35 5	35 11	36 6	35 8	35 8	35 1	35 9
1895	34 7	34 4	34 4	34 8	35 6	35 2	36 1	37 1	38 10	38 6	37 11	37 6	36 3
1896	37 3	38 4	38 7	38 1	37 4	37 4	36 11	36 11	37 11	39 2	40 5	40 5	38 3
1897	41 2	40 4	40 5	39 2	39 7	40 9	39 6	40 5	41 7	42 5	41 5	40 4	40 7
1898	40 9	40 8	40 6	40 0	40 7	39 11	40 4	41 11	43 0	44 11	49 1	44 3	42 0
1899	46 10	47 11	47 9	49 10	55 11	62 10	71 6	65 9	67 7	68 8	70 0	66 9	60 5
1900	67 10	68 10	73 10	76 2	74 2	68 6	69 3	71 4	70 9	67 8	63 6	53 6	68 9
1901	48 0	46 6	45 8	45 5	45 10	44 7	44 6	45 3	45 3	43 6	43 1	43 1	45 3
1902	43 11	46 7	46 9	47 11	48 10	49 7	50 9	52 1	53 6	52 9	50 9	47 11	49 3
1903	47 3	48 9	51 10	49 0	46 1	46 2	46 7	46 8	45 7	43 6	42 10	41 11	46 4
1904	42 3	42 7	43 3	44 7	44 0	42 10	42 9	43 3	43 1	43 9	46 1	48 7	43 11
1905	48 11	48 0	49 6	50 1	51 5	45 6	45 9	47 5	48 8	52 11	52 9	53 3	49 6
1906	53 9	50 1	48 1	48 8	50 2	50 3	50 6	53 0	54 6	56 8	58 6	62 4	53 6
1907	60 4	56 6	54 10	56 0	61 1	58 1	57 8	57 8	55 7	54 8	50 8	50 0	56 2
1908	48 5	49 3	51 7	51 10	51 6	51 2	50 0	51 4	52 0	49 8	49 4	48 11	50 8
1909	48 10	48 1	46 9	47 9	48 4	48 9	48 6	50 5	51 3	51 11	51 2	50 7	49 4
1910	51 10	51 3½	51 7½	50 10	49 10	49 2	48 10	49 8½	49 3½	49 7½	49 6½	49 10	50 4
1911	49 11½	49 2½	48 5	46 11	46 4	46 6	46 11½	47 4	47 0	46 7	47 4½	48 1	47 7
1912	50 0	49 5½	51 1½	53 7½	54 4	55 1	57 5½	64 6½	61 7½	66 8½	67 8	68 0	58 5½
1913	66 11½	63 8½	64 8	67 1½	66 3	56 9½	56 3½	55 8	55 4	53 0	50 1	50 4	58 10
1914	50 11	51 5½	51 0½	51 4½	51 6	51 6½	51 5	52 3	51 5	50 1	50 3	53 0	51 4½
1915	55 7	56 6	61 0	66 7	65 2	66 10	65 4	66 0½	65 3	65 11	69 10½	75 7½	65 7
1916	80 2	91 6	87 4½	86 10	82 6	82 6	87 6	87 6	87 6	87 6	87 6	87 6	85 10
1917	87 6	87 6	87 6	92 6	92 6	92 6	92 6	92 6	92 6	92 6	92 6	95 0	99 3
1918	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0
1919	95 0	95 0	95 0	95 0	152 6	160 0	160 0	160 0	160 0	160 0	160 0	160 0	137 8
1920	175 0	175 0	187 6	200 0	208 0	217 6	217 6	221 0	225 0	225 0	225 0	225 0	209 3
1921	222 6	195 0	150 0	126 0	120 0	120 0	120 0	136 3	127 0	120 0	110 0	100 0	137 4
1922	92 6	90 0	90 0	90 0	90 0	90 0	89 0	87 3	92 6	92 6	92 6	91 3½	90 7½
1923	94 6	108 9	125 6	129 4½	128 5	136 0	128 1½	121 11	97 1½	97 0	100 0	100 0	110 6½
1924	99 10	97 3½	91 9	93 9	91 9	89 10½	87 9	85 0	82 5½	80 2½	81 9	81 9	88 7½
1925	80 4½	78 10½	78 0	78 3	76 0	73 10½	71 7½	69 10½	68 1½	66 7½	66 0	66 10½	72 10½
1926	69 4½	70 0	70 0	70 0	72 6	75 10½	86 7½	90 0	93 10½	117 10	120 0	99 0	86 3
1927	85 0	83 1½	81 0	80 0	73 9	70 0	70 0	68 9	67 6	67 6	66 10½	65 0	78 2½
1928	65 0	65 0	65 6	66 0	66 0	66 0	66 0	66 0	66 0	66 0	66 0	66 0	65 9½
1929	66 0	66 9	67 0	68 1½	69 5	71 10½	72 9	72 6	72 6	72 6	72 6	72 6	70 4.5
1930	72 6	72 6	70 0	67 6	67 6	67 6	67 6	64 6	63 6	63 6	63 6	63 6	66 11½
1931	59 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	—	—

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(A remittance should accompany instructions.)

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BRASS Moulder, unemployed, seeks engagement as Working Foundry Foreman; full knowledge of melting and mixing of aluminium, nickel, and all non-ferrous alloys; 23 years' practical experience in motor and engineering trades; Manchester district preferred.—Box 950, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

TECHNICAL Representative, with experience of patternshop, foundry, and modern machining methods. Good prospects.—Apply, giving age and summary of experience as above, Box 956, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

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Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

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3 ft. 6 in. "Evans" Sandmill		£15
4 ft. 6 in. "Evans" Sandmill	...	£20
"Jackman" Rotary Sifter	...	£8
"Herbert" sand whizzer	...	£32
"Jackman" sand whizzer	...	£12
No. 0 "Jackman" Cupola	...	£32
Two "NORTON" D.E. fettling grinders	each	£14

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PETER—WITH ONE EXCEPTION

With one exception Peter is an ordinary little fellow. Chubby, likeable, just five-and-a-half, full of life and fun, and on occasions—be it admitted—of naughtiness. Just now Peter's rather important, for this is his first term at school, and he's grappling with the intricacies of "A B C" and "Twice-Two": difficult subjects to all men of five-and-a-half, but even more difficult in Peter's case because—bad luck—he's totally blind. That's his One Exception. Peter learns reading, writing, and 'rithmetic through the medium of "Braille"—dull stuff compared with the coloured picture books of most five-and-a-halfs. However, he's a stout lad is Peter, and he's making great progress.

Would you like to know more about him? How, in spite of his "One Exception," he is being educated and, when older, technically trained and usefully employed.

There is a long waiting list of "Peters" throughout the British Isles, for whom training and accommodation must be provided in the immediate future.

Will you help with a donation or annual subscription? Any sum, large or small, will be gratefully received.

Here's a suggestion. Your eyesight is worth 3d. a year to you. Send Peter and his handicapped pals 3d. for every year you've had it. Now, please, in case it slips your memory. Good idea?

The Chairman,

SCHOOL FOR THE BLIND
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